MIDDLE AND UPPER CAMBRIAN POLYMERID TRILOBITES AND BIOSTRATIGRAPHY, FENGHUANG AREA, WESTERN HUNAN PROVINCE, CHINA

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Middle and Upper Cambrian polymerid trilobite faunas are described from the Fengmuping, Laochatian, Tingziguan and Jiantang Formations of the Haichongkou section in the Fenghuang area, Western Hunan Province, China. A total of 32 species belonging to 29 genera and subgenera are described, including *Trigocephalus* gen. nov. and *Tuojiangella* gen. nov., and 7 new species (*Corynexochus hunanensis* sp. nov., *Onchonotellus fenghuangensis* sp. nov., *Trigocephalus trigoformis* gen. et. sp. nov., *Tuojiangella tuojiangensis* gen. et. sp. nov., *Pseudoyuepingia jiantangensis* sp. nov., *Koldinioidia (Liriamnica) labakouensis* sp. nov. and *Ivshinaspis formosa* sp. nov.). Four trilobite assemblages and their correlations with trilobite faunas of China and overseas are outlined.

THIS paper deals with the polymerid trilobites of Middle and Upper Cambrian strata in the Fenghuang area, Western Hunan, China (Fig. 1). This area is one of the most richly fossiliferous areas in China for Middle and Upper Cambrian trilobites, yielding abundant polymerids and agnostids. Field investigation in 1992 and 1995 of the Cambrian sequence stratigraphy and 1:50 000 regional geological mapping of this area had been carried out by the senior author. The purpose of this paper is to document the Middle and Upper Cambrian polymerid trilobites; agnostids are also being studied and will be published elsewhere.

The trilobites from the Fenghuang area have been regarded as belonging to the 'Transitional Type' of Lu et al. (1974), or the 'platform margin type' of the Yangtze biome Yang (1988), situated between faunas of the 'North-China Type' dominated by benthic polymerids and the 'Southeast-China Type' typified by abundant planktonic agnostids. The Fenghuang trilobite fauna is an admixture of abundant angnostids and polymerids. Trilobites described in this paper were collected from the Haichongkou section 15 km northwest of Fenghuang county (Fig. 1).

Palaeogeographically, the Fenghuang area was located within the Jiangnan Slope Belt during the Middle and Late Cambrian, lying between the Yangtze Platform (of the 'North-China Type' of Lu et al. 1974) and the Jiangnan Basin (of the 'Southeast-China Type' of Lu et al. 1974) (Fig. 1). Middle and Upper Cambrian deposits of this area are dominated by carbonates including dolostones.

STRATIGRAPHY

The Middle and Upper Cambrian strata of the Haichongkou section are assigned to five formations (Fig. 2).

Tonggutan Formation (70 m). Mainly of thick-bedded dolostone; unfossiliferous; it is referred to the Middle Cambrian in accordance to the overlying Middle Cambrian faunas.

Fengmuping Formation (about 275.3 m thick). Argillaceous limestone interbedded with thin-bedded lime-rubbly limestone in the middle and upper parts; and laminated argillaceous limestone interbedded with silty shale in the lower part. Most of the trilobites contained here (Fig. 2) are known in the Middle Cambrian in South China. In particular, *Prodamesella* Chang is considered an index of the Middle Cambrian in South China (Yang 1978).

Laochatian Formation (about 35 m thick). Mainly limestone breccia interbedded with thin-bedded limestone (Beds 16–20 in Fig. 2). *Shengia* Hsiang and *Proceratopyge* Wallerius, both key elements of the *Liostracina–Chatiania* Zone of the early Late Upper Cambrian in Western Hunan (Yang 1978), indicate that the Laochatian Formation is early Late Cambrian in age.

Tingziguan Formation (about 474.7 m thick). It is composed mainly of carbonates and characterised

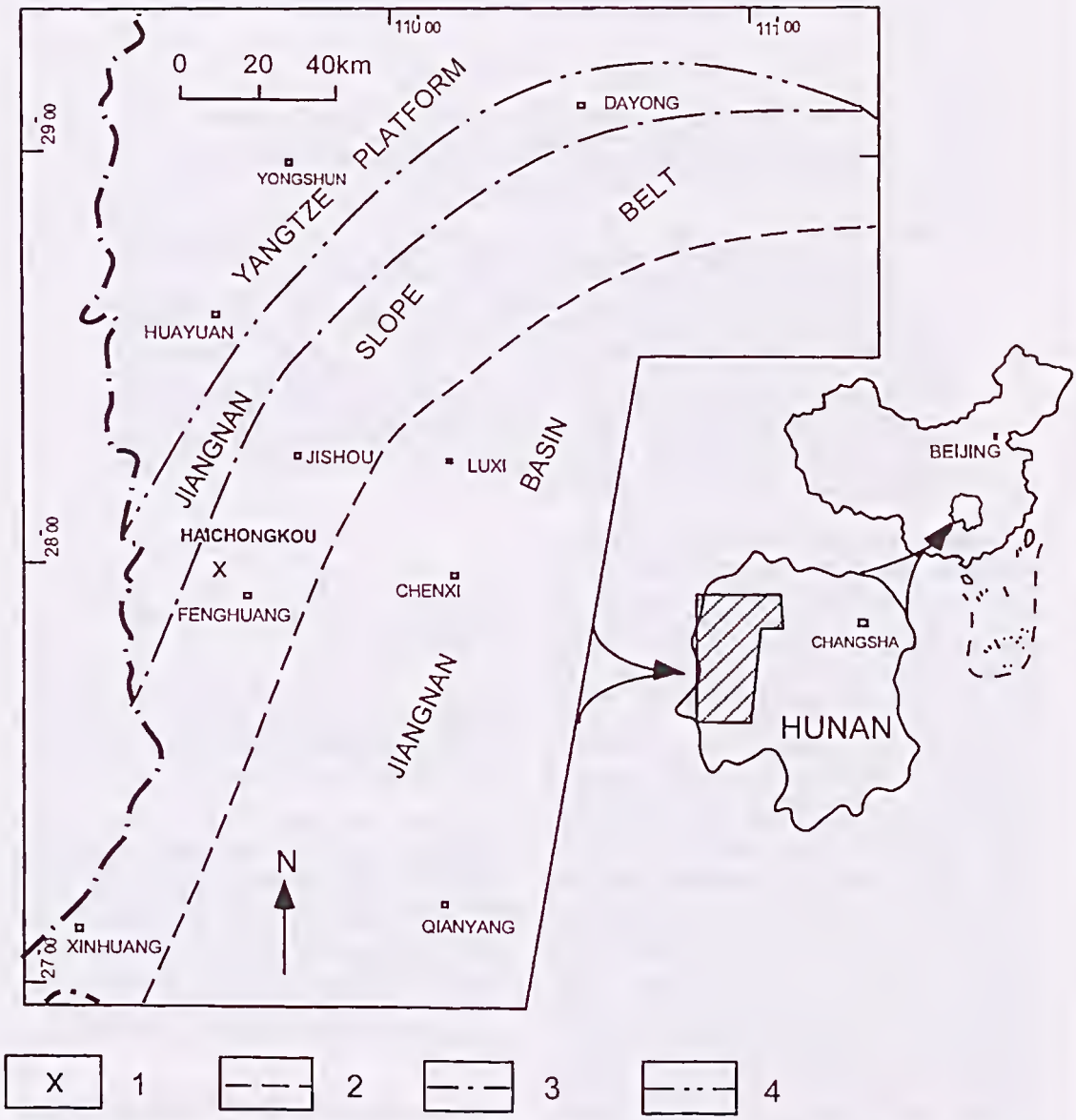
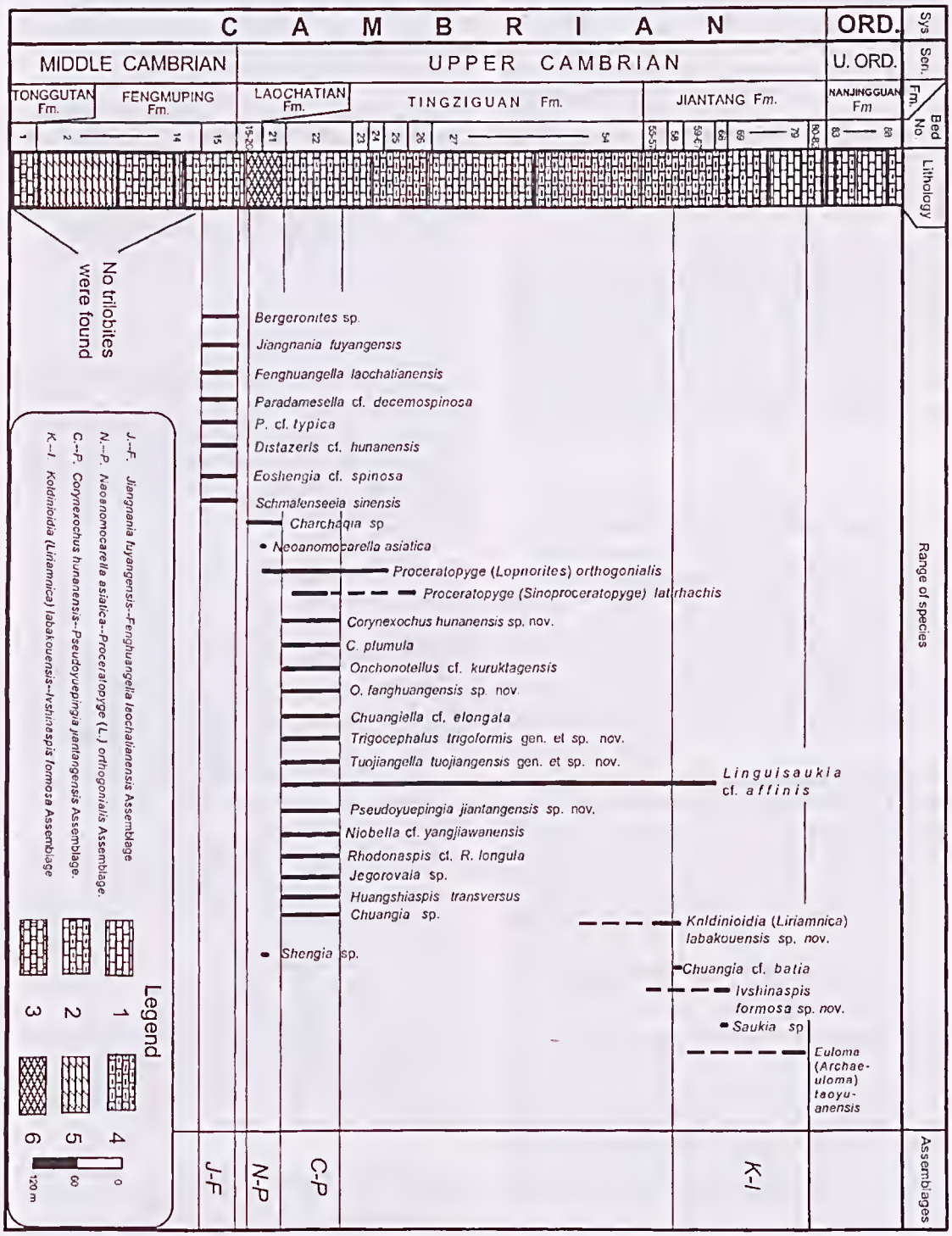


Fig. 1. Geological sketch and distribution of the Middle and Upper Cambrian in west Hunan, with Middle and Upper Cambrian biogeographical regions. *Legend:* 1, location of measured section; 2, south boundary of the Jiangnan Slope Belt in mid–late Late Cambrian; 3, north boundary of the Jiangnan Slope Belt in late Late Cambrian; 4, north boundary of the Jiangnan Slope Belt in middle Late Cambrian to early Late Cambrian.

Fig. 2. Stratigraphical distribution of trilobite species in the Fengmuping, Laochatian, Tingziguan and Jiantang Formations of the Haichongkou Section, Western Hunan, China. *Legend:* 1, limestone; 2, argillaceous limestone interbedded with limestone breccia; 3, dolostone; 4, argillaceous limestone; 5, silty shale; 6, lime-rubble rock.


CAMBRIAN
ORD.
Sys
MIDDLE CAMBRIAN
UPPER CAMBRIAN
U. ORD.
Ser.
TONGGUTAN Fm.
FENGMUPING Fm.
LAOCHATIAN Fm.
TINGZIGUAN Fm.
JIANTANG Fm.
NANJINGGUAN Fm
Fm.
Bed No.
Lithology
No trilobites were found
Bergeronites sp.
Jiangnania fuyangensis
Fenghuangella laochatianensis
Paradamesella cf. decemospinosa
P. cf. typica
Distazeris cf. hunanensis
Eoshengia cf. spinosa
Schmalenseeia sinensis
Charchaqia sp
Neoanomocarella asiatica
Proceratopyge (Lopnorites) orthogonialis
Proceratopyge (Sinoproceratopyge) latirhachis
Corynexochus hunanensis sp. nov.
C. plumula
Onchonotellus cf. kuruktagensis
O. fanghuangensis sp. nov.
Chuangiella cf. elongata
Trigocephalus trigoformis gen. et sp. nov.
Tuojiangella tuojiangensis gen. et sp. nov.
Linguisaukia cf. affinis
Pseudoyuepingia jiantangensis sp. nov.
Niobella cf. yangjiawanensis
Rhodonaspis cf. R. longula
Jegorovaia sp.
Huangshiaspis transversus
Chuangia sp.
Shengia sp.
Koldinioidia (Liriamnica) labakouensis sp. nov.
Chuangia cf. batia
Ivshinaspis formosa sp. nov.
Saukia sp
Euloma (Archaeuloma) taoyuanensis
Range of species
Assemblages
J-F
N-P
C-P
K-1
Legend
J.-F. Jiangnania fuyangensis--Fenghuangella laochatianensis Assemblage
N.-P. Neoanomocarella asiatica--Proceratopyge (L.) orthogonialis Assemblage.
C.-P. Corynexochus hunanensis--Pseudoyuepingia jiantangensis Assemblage.
K.-I. Koldinioidia (Liriamnica) labakouensis--Ivshinaspis formosa Assemblage
1
2
3
4
5
6
0
60
120 m

by rubbly limestone interbedded with argillaceous limestone in the upper part; argillaceous limestone interbedded with rubbly limestone in the middle part; and argillaceous limestone interbedded with thin-bedded limestone breccia (Beds 21–54 in Fig. 2) in the lower part. Of these species, *Pseudoyuepingia* sp., *Chuangia* sp. and *Proceratopyge (Sinoproceratopyge) latirhachis* Zhou are known in the *Chuangia–Prochuangia* Zone of the Upper Cambrian in Western Hunan (Yang 1978) and these genera are common in the Upper Cambrian of North China.

Jiantang Formation (about 215.7 m thick). Argillaceous limestone interbedded with rubbly limestone in the lower part; and mainly argillaceous limestone interbedded with rubbly limestone in the middle and upper parts (Beds 55–82 in Fig. 2). *Chuangia* cf. *batia* (Walcott) is characteristic of the Gushanian and Changshanian of North China and the Upper Cambrian of Western Hunan.

BIOSTRATIGRPHY AND PALAEOECOLOGY

Based on the stratigraphic distribution of trilobite's species (see Fig. 2), four assemblages are recognised in the Haichongkou section (Fig. 2). The lower boundary of each assemblage is defined by the first appearance of certain trilobites species, while the top of each assemblage is defined by the last occurrence of the same or some other species.

Jiangnania fuyangensis–Fenghuangella laochatianensis Assemblage. This assemblage occurs in argillaceous limestone interbedded with thin limestone breccia and shale (Bed 15; Fig. 2). The substrate was soft in a low-energy environment, probably at a basin margin or on the middle and lower parts of a platform margin slope. This assemblage is characterised by the first appearance of *Jiangnania fuyangensis* Lu & Lin. Regionally, this assemblage occurs in the Tingziguan and Laochatian areas, some 10 km east of the Haichongkou section, where the correlative trilobites were considered to be the typical forms of the 'Transitional Type' Fauna by Lu et al. (1974). The same trilobite fauna has also been found in the *Paradamesops jinaensis–Cyclolorenzella tuma* Subzone of the *Lejopyge armata* Zone in northwestern Hunan and eastern Guizhou provinces (Yang 1978, 1984; Peng 1987, 1992; Dong 1990, 1991; Lin 1991).

In addition, some key elements such as *Paradamesella* cf. *decemospinosa* Yang and *P.* cf. *typica* Yang of the present assemblage were also reported from the *Damesella torosa–Ascionepea janitrix* Zone of the Middle to Upper Cambrian of Queensland (Öpik 1961, 1967).

Neoanomocarella asiatica–Proceratopyge (Lopuorites) orthogonialis Assemblage. This assemblage extends over some 35 m thick strata, corresponding approximately to the rubbly limestone interbedded with thin bedded limestone (Beds 16–21) of the Laochatian Formation (Fig. 2). The assemblage is marked by the first appearance of *Neanomocarella asiatica* Hsiang. In addition, *Proceratopyge (L.) orthogonialis* Yang is also found in a great quantity; *Charchaqia* sp and *Shengia* sp. are also important members of the assemblage. Most of these elements were thought of as typical forms of the 'Transitional Type' Faunas of Lu et al. (1974) and have also been reported from the *Liostracina–Chatiania* Assemblage Zone of northwestern Hunan and eastern Guizhou provinces (Yang 1978, 1984; Peng 1987, 1992; Dong 1990, 1991; Lin 1991), and from the Upper Cambrian of North China (Lu et al. 1982).

Coryuexochus hunanensis–Pseudoyuepingia jiantangensis Assemblage. This assemblage is recognised from the interbeds of the rubbly limestone and argillaceous limestone (Bed 22) of the Tingziguan Formation (Fig. 2). The fine grained and muddy lithology suggests that the trilobites probably lived in a varied environment, ranging from the middle part to the middle and upper parts of a gentle slope of a carbonate platform. The abundant occurrence of *Corynexochus hunanensis* sp. nov. and *Pseudoyuepingia jiantangensis* sp. nov. defined this assemblage.

Several other new species also occur in this assemblage: *Onchonotellus fenghuangensis* sp. nov. *Trigocephalus trigoformis* gen. et. sp. nov. and *Tuojingella tuojiangensis* gen. et. sp. nov. Some of these, including *Onchontellus* cf. *kurukiagensis* Zhang, *O. fenghuangensis* sp. nov., *Chuangiella* cf. *elongata* Kobayashi, *Trigocephalus trigoformis* sp. nov. and *Tuojiangella tuojiangensis* sp. nov. are key elements of the *Irvingella* Assemblage Zone of the 'Transitional Type' Fauna by Lu et al. (1974) from northwest Hunan and eastern Guizhou provinces (Yang 1978, 1984; Peng 1987, 1992; Dong 1990, 1991; Lin 1991).

Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage. The frequent occurrences of *Koldinioidia (L.) labakouensis* sp. nov. and

Ivshinaspis formosa sp. nov. characterise this assemblage, which is found in the muddy-limestone interbedded with rubbly limestone (Beds 58–79) of the Jiantang Formation (Fig. 2). These lithological features suggest that the substrata on which these trilobites lived were lime mud, corresponding probably to the middle–upper parts of a gentle slope of a carbonate platform.

Other trilobite species are *Chuangia* cf. *batia* Walcott, *Saukia* sp. and *Enloma (Archaeuloma) taoyuanensis* Peng. Among these, *Koldinioidia (L.) labakouensis* sp. nov. and *Saukia* sp. were also found in the *Lotagnostus (L.) punctatus–Hedinaspis regalis* Assemblage Zone in northwest Hunan (Yang et al. 1984).

SYSTEMATIC PALAEONTOLOGY

Terminology follows Moore (1959). Material is housed in Museum Victoria, Melbourne (NMV P). Each measured and illustrated specimen bears a field collection number (eg. HFH 22.29-1), where HFH stands for Hunan Fenghuang Haichongkou Section, 22 number of bed, 29 number of specimen from the bed, and 1 number of this fossil.

Order PTYCHOPARIIDA Swinnerton, 1915

Suborder ASAPHINA Salter, 1864

Superfamily ASAPHOIDEA Burmeister, 1843

Family ASAPHIDAE Burmeister, 1843

Subfamily NIOBINAE Jaanusson, 1959

Genus **Niobella** Reed, 1931

Type species. *Niobe homfrayi* Salter, 1866.

Niobella cf. **yangjiawanensis** Chien, 1961

Fig. 3A–C

cf. *Niobella yangjiawanensis* Chien 1961: 105, pl. 3, figs 1, 2.
cf. *Niobella yangjiawanensis*—Lu et al. 1965: 502, pl. 102, fig. 3.
cf. *Niobella yangjiawanensis*—Lu & Lin 1989: 144, pl. 23, fig. 7.

Material. NMV P1456713, collection number HFH 22.29-1; NMV P1456714, collection number HFH 22.28-2; NMV P1456715, collection number HFH 22.55-1.

Description. Pygidium semicircular; axis conical, moderately convex with four to five rings and a terminal lobe, its width is about one-quarter that of pygidium; pleural and interpleural furrows weak, dividing pleural region into five to six ribs; border flat and wide, with fine co-marginal terrace lines on external surface.

Comments. These specimens are very similar to the holotype of *N. yangjiawanensis* Chien (1961: 105, pl. 3, figs 1, 2) from the Upper Cambrian of southeastern Guizhou, but are distinguished by having an axis with seven to eight rings, narrow, about one-fifth width of pleural region. This species differs from *N. chui* Lu et al. (1965: 501, pl. 101, figs 4–6) in that the latter has an axis of pygidium with 8 to 10 axial segments; pleural region with 6 to 7 pleurae; and pronounced pleural furrows extending to the border.

Stratigraphic horizon. *Corynexochus hunanensis–Pseudoyuepingia jiantangensis* Assemblage, Upper Cambrian.

Superfamily CERATOPYGOIDEA Linnarsson, 1869

Family CERATOPYGIDAE Linnarsson, 1869

Subfamily PSEUDOYUEPINGIINAE Lu & Lin, 1989

Genus **Pseudoyuepingia** Chien, 1961

[= **Iwayaspis** Kobayashi, 1962]

Type species. *Pseudoyuepingia modesta* Chien, 1961.

Discussion. Chien (1961) erected the genus on the basis of specimens from the Upper Cambrian of Guizhou. *Iwayaspis* Kobayashi (1962) is considered a junior synonym of *Pseudoyuepingia*. *Pseudoyuepingia* is comparable to *Proceratopyge* Wallerius (1895), but the latter has stronger glabellar furrows and a pair of lateral spines on the pygidium.

Pseudoyuepingia jiantangensis sp. nov.

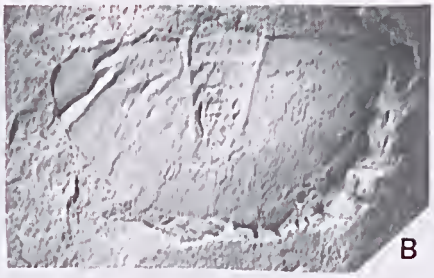
Figs 3E, F, H; 4A, B; 5a, b

Etymology. For Jiantang village, where these specimens were collected.

Holotype. NMV P1456716, collection number HFH 22.38-1, a complete cranidium.

Paratypes. NMV P1456717, collection number HFH 22.33; NMV P1456718, collection number HFH 22.37-1; NMV P1456780, collection number HFH 22.10-3; NMV P1456781, collection number HFH 22.57. A cranidium and nine pygidia are available.


A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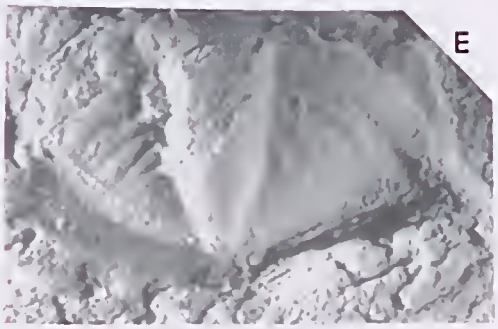
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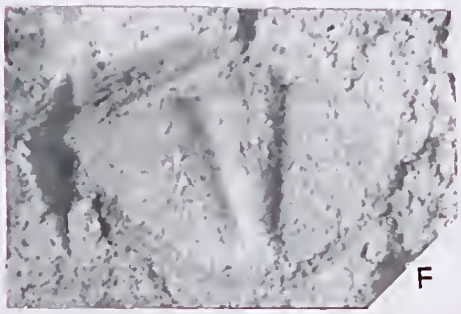
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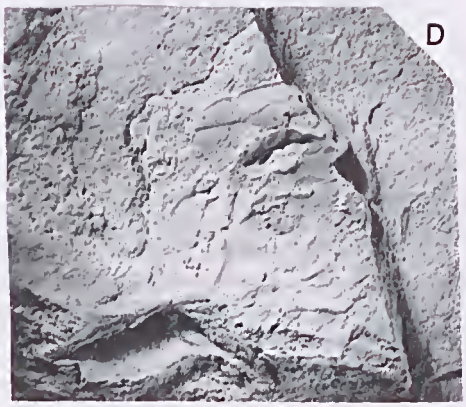
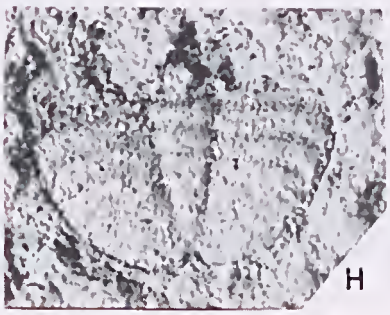

D


G


C


H

Diagnosis. Miniature trilobite; glabella almost parallel-sided and convex; preglabellar field long and flat; fixigena relatively narrow and slightly convex; posterolateral limbs narrow and triangular.

Description. Cranidium subtriangular, slightly convex; glabella nearly subtriangular, truncated in the front, with a small node at the posterior just in front of the occipital furrow; axial furrows wide and shallow; glabellar furrows indistinct. Palpebral lobes comparatively large, about half of glabellar length, just anterior to the glabellar midlength. Occipital furrow wide, shallow, connecting with axial furrows; occipital ring uniformly of moderate width; fixigena narrow, less than half glabellar width (Gn). Posterior border furrows shallow and wide; posterolateral limbs triangular and narrow; preglabellar field depressed; anterior border slightly upturned. Anterior sections of facial suture almost parallel. Pygidium broad and elliptical; axis convex and conical in outline, about one-third as wide as pygidium (Wp), with 4 axial segments and a conical shaped terminal axial segment protruding into the marginal border; axial furrows pronounced; pleural regions flattened, with 4 to 5 pairs of wide and shallow pleural furrows, first pair of pleural furrows extending into border. Border wide and gently convex, ornamented by many terraces at the anterior of border.

Discussion. This species differs from *P. zhejingensis* Lu & Lin (1989: 155, pl. 27, figs 2–5) by its more rounded glabellar anterior, and its shorter and deeper anterior border furrow. The occipital furrow of the new species is indistinct, and its pygidial pleural furrows are deeper and narrower.

The new species also differs from *P. elongata* Lu & Lin (1989: 156, pl. 27, figs 6–8) by possessing a longer posterior cranidium and a narrower and longer glabella. The new species is similar to *P. brevica* Lu & Lin (1989: 156, pl. 27, figs 9–13), but differs from the latter by its wider glabella in the latero-posterior part and smaller palpebral lobes near the glabella, whereas the axis of the pygidium of the latter is shorter and wider than that of the new species. *P. intermedia* Lu & Lin (1989: 157, pl. 28, figs 2–5) is unable to be confused with the new species by its smaller palpebral lobes about one-third as long as glabella (Gn). The new species also differs from *P. laochatianensis* Yang (1987: 69, pl. 3, figs 5–17) by its posterior cranidium with 3 pronounced semicircular glabellar furrows.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyuepingia jiantangensis Assemblage, Upper Cambrian.

Genus **Charchaqia** Troedsson, 1937

Type species. Charchaqia norini Troedsson, 1937.

Charchaqia sp. indet.

Fig. 4C

Material. NMV P1456719, collection number HFH 20.4.

Comments. This is a juvenile pygidium, semicircular in outline; axis narrow and moderately convex; pleura indistinct. These features indicate a new species, but we prefer to retain it in open nomenclature due to lack of sufficient material.

Stratigraphic horizon. Neoanomocarella asiatica–Proceratopyge (L.) orthogonialis Assemblage, Laochatian Formation, Upper Cambrian.

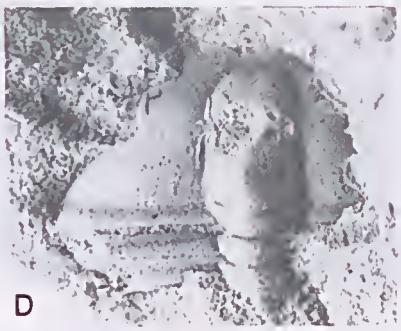
Genus **Proceratopyge** Whallerius, 1895

Subgenus **Proceratopyge (Lopnorites)** Troedsson, 1937

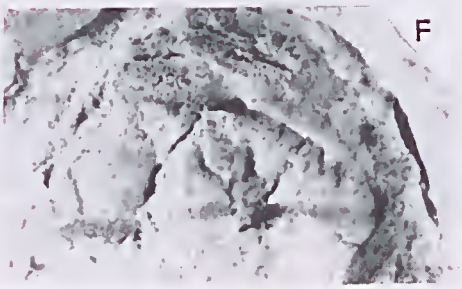
Type species. Proceratopyge (Lopnorites) rectispinatus Troedsson, 1937.

Discussion. The most important morphological characteristics distinguishing this subgenus from the other two subgenera, *Proceratopyge* Wallerius and *Lopnorites* Troedsson, are the broad and short cranidium with equally spaced palpebral lobes, the divergent anterior facial sutures forming 45° angle with the axial line, and the cylindrical glabella marked by four pairs of pronounced lateral furrows.

Fig. 3. A–C, *Niobella* cf. *yangjiawanensis* Chien. A, NMV P1456713; (HFH 22.29-1), a pygidium, ×2.5. B, NMV P1456714; (HFH 22.28-2), an external model of pygidium, ×2.5. C, NMV P1456715; (HFH 22.55-1), an incomplete pygidium, ×2.4. D, G, *Proceratopyge (Sinoprocreatopyge) latirhachis* Zhou. D, NMV P1456723; (HFH 26.01-1), an incomplete cranidium, ×1.8. G, NMV P1456724; (HFH 26.03), a pygidium, ×6.8. E, F, H, *Pseudoyuepingia jiangangensis* sp. nov. E, NMV P1456717; (HFH 22.33), Paratype, a pygidium, ×6. F, NMV P1456780; (HFH 22.10-3); Paratype, a pygidium of the larval age, ×23. H, NMV P1456781; (HFH 22.57), a pygidium of the larval age, ×27.


D


E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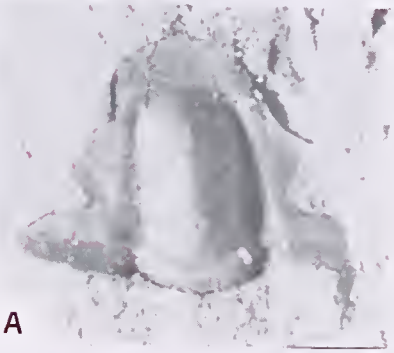
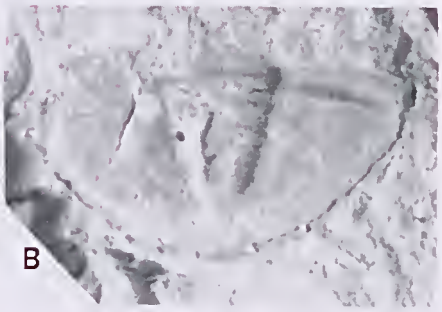

A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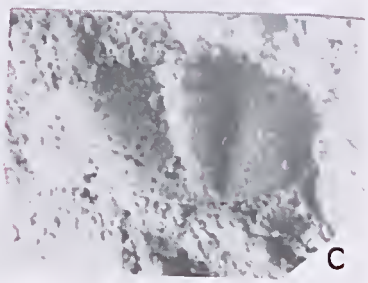
C


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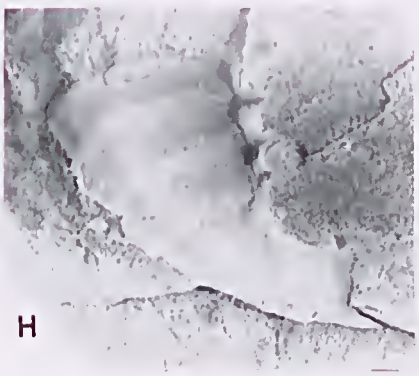

H

Fig. 5. Pseudoyuepingia jiangtangensis sp. nov. a, from NMV P1456716; (HFH 22.38-1), cranidium, ×37. b, from NMV P1456717; (HFH 22.33), a pygidium, ×6.6.

Proceratopyge (Lopnorites) orthogonialis Yang, 1978

Figs 4D, E; 6A

Proceratopyge (Lopnorites) orthogonialis Yang 1978: 68, pl. 3, figs 1–4; pl. 7, fig 21.

Material. NMV P1456720, collection number HFH 25.02-2; NMV P1456721, collection number HFH 21.03; NMV P1456722, collection number HFH 21.07.

Comments. The present specimens consist of some incomplete cranidia, shield and complete pygidia. These materials are close to the holotype of *P. (L.) orthogonialis* Yang (1978: 68, pl. 21; pl. 3, figs 1–4) although the anterior palpebral lobes are slightly shorter.

This species differs from *Lopnorites grabaui* Troedsson (1937: 37, pl. 2, figs 7, 8; pl. 3, figs 2, 3) and *P. (S.) kiangshanensis* Lu & Lin (1989: 151, pl. 25, figs 4–10) by its flat and straight glabella in the front, a wider anterior border. The latter two species possess a cylindrical and straight glabella, a flat frontal area and bigger palpebral lobes.

The species is also comparable with *P. cylindrica* Chien (1961: 107, pl. 3, figs 8–10), from which it may be distinguished by its acute antero-lateral corners of the pygidium and a narrower axis lobe. The pygidium of the present species is most similar to that of *P. magnicauda* Westergard (1947: 9, pl. 2, fig. 11; 1948: 6, pl. 1, fig. 17) but the latter has a narrower axial lobe with more segments.

Stratigraphic horizon. Neoanomocarella asiatica–Proceratopyge (L.) orthogonialis Assemblage, Laochatian Formation, Upper Cambrian.

Subgenus **Proceratopyge (Sinoproceratopyge)** Lu & Lin, 1980

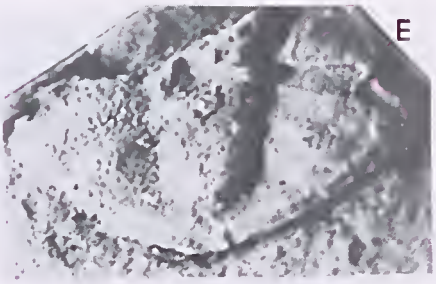
Type species. Proceratopyge kiangshanensis Lu (in Wang 1964).

Proceratopyge (Sinoproceratopyge) latirhachis Zhou, 1977

Figs 3D, G; 6B, C

Proceratopyge latirhachis Zhou 1977: 233, pl. 70, figs 14–16.

Fig. 4. A, B, *Pseudoyuepingia jiangtangensis* sp. nov. A, NMV P1456716; (HFH22.38-1), Holotype, a cranidium, ×22.5. B, NMV P1456718; (HFH22.37-1), Paratype, a pygidium, ×9.9. C, *Charchaq* sp. Troedsson. NMV P1456719; (HFH 20.4), a pygidium of the larval age, ×19.8. D, E, *Proceratopyge (Lopnorites) orthogonialis* Yang. D, NMV P1456720; (HFH 25.02-2), an incomplete cranidium, ×10.8. E, NMV P1456722; (HFH 21.07), a pygidium, ×3.2. F, *Jegorovaia* sp. NMV P1456730; (HFH 22.71-1), a cranidium, ×10.8. G, *Euloma (Archaeuloma) taoyuanensis* Peng. NMV P1456740; (HFH 79.01), a curl external model of enrolment specimen including a pygidium and a part of thoracic segments attached, ×5.4. H, *Neoanomocarella asiatica* Hsiang. NMV P1456735; (HFH 21.01), a fragmentary of pygidium, ×4.5.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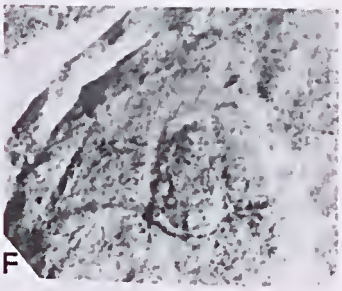
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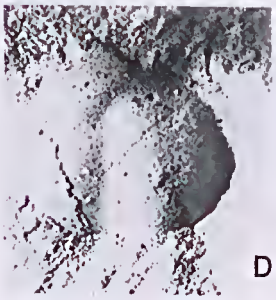
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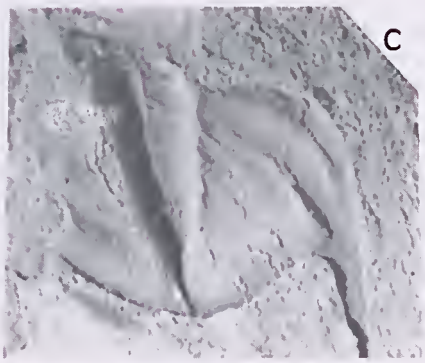

C

Material. NMV P1456723, collection number HFH 26.01-1; NMV P1456724, collection number HFH 26.03; NMV P1456725, collection number HFH 26.06; NMV P1456726, collection number HFH 26.09.

Description. Glabella contracted slightly forward and rounded anteriorly; glabellar furrows very weak; palpebral lobes large and semicircular; fixigena about half as wide as glabella (Gn). Frontal area wide and concave; anterior border narrow and upturned. Pygidium semicircular, axis of pygidium wide and gently contracted backward, consisting of 7 segments; terminal axial segment sharp; the first pair of pleural furrows wide and deep, pleurae large, extending into a pair of spines; border wide and slightly concave.

Comments. When compared with *P. (S.) changshanensis* Lu & Lin (1989: 153, pl. 26, figs 6–8), the present species differs by its glabella being contracted more strongly in the front, possessing a wider axis in the pygidium, narrower pleural lobes and longer spines.

The present species can be distinguished from *P. fragilis* Troedsson (1937: 36, pl. 2, figs 3–6) by its longer pygidium (Lp2), wider axis, fewer segments, narrower pleurae, and concave and wider border.

Stratigraphic horizon. Corynexochus hunaensis–Pseudoyepingia jiantangensis Assemblage, Tingziguan Formation, Upper Cambrian.

Superfamily LEIOSTEGIOIDEA Bradley, 1925

Family LEIOTEGIIDAE Bradley, 1925

Subfamily LEIOSTEGIINAE Bradley, 1925

Genus **Chuangia** Walcott, 1911

Type species. Ptychoparia? batia Walcott, 1905.

Chuangia cf. **batia** Walcott, 1911

Fig. 6D

cf. *Chuangia batia* Walcott 1911: 84, pl. 15, figs 3, 3a.

Material. NMV P1456727, collection number HFH 58.01.

Comments. This is an incomplete cranidium. Glabella tapered and obtusely-rounded in the front, moderately convex. Glabellar furrows very weak; axial and occipital furrows shallow. Compared with the holotype, the present specimen differs slightly in its narrower frontal area.

Stratigraphic horizon. Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, Upper Cambrian.

Chuangia sp. indet.

Fig. 6E

Material. NMV P1456728, collection number HFH 22.32.

Comments. The specimen is an incomplete pygidium, subtriangular-semicircular in shape. Axis convex, and anterior axial segments pronounced, consisting of three segments and a terminal segment. Pleural region wide and flat. Pleural and interpleural furrows indistinct, with a very narrow border. The present specimen differs from *C. wulingensis* Yang (1978: 54, pl. 9, figs 10–12), in that the axis of the pygidium in the latter species is more convex, and its axial segments more pronounced. Because no cranidium was found, and the pygidium is poorly preserved, the species identity is undecided.

Genus **Chuangiella** Kobayashi, 1935

Type species. Chuangiella elongata Kobayashi, 1935.

Chuangiella cf. **elongata** Kobayashi, 1935

Fig. 7A

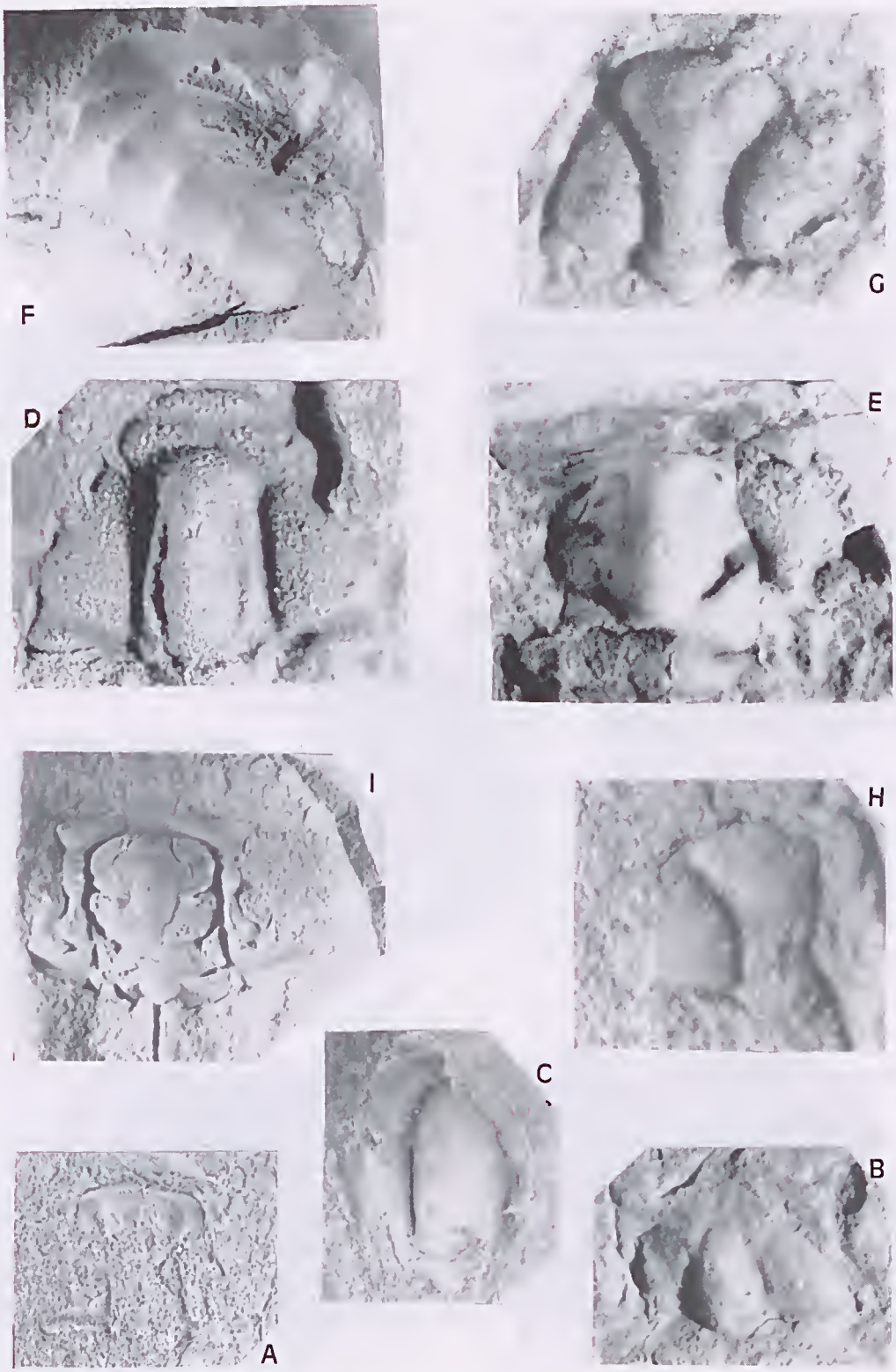
cf. *Chuangiella elongata* Kobayashi 1935: 191, pl. 10, fig. 18.

cf. *Chuangiella elongata*—Lu et al. 1965: 372, pl. 69, fig. 9.

cf. *Chuangiella elongata*—Zhou et al. 1977: 192, pl. 56, fig. 13.

cf. *Chuangiella elongata*—Yang et al. 1991: 165, pl. 20, figs 11–14.

Fig. 6. A, *Proceratopyge (Lopnorites) orthogonialis* Yang. NMV P1456721; (HFH 21.03), an exoskeleton of cranidium crushed, ×6.8. B, C, *P. (S.) latirhachis* Zhou. B, NMV P1456725; (HFH 26.06), an external model of pygidium, ×8. C, NMV P1456726; (HFH 26.09), an incomplete pygidium, ×5.9. D, *Chuangia* cf. *batia* Walcott. NMV P1456727; (HFH 58.01), an incomplete cranidium, ×7.2. E, *Chuangia* sp. NMV P1456728; (HFH 22.32), a pygidium, ×10.8. F, *Trigocephalus trigonformis* gen. et. sp. nov. NMV P1456732; (HFH 22.14-2), Paratype, a cranidium, ×22.5. G, *Euloma (Archaeuloma) taayuanensis* Peng. NMV P1456733; (HFH 80.01), a complete external model of exoskeleton, ×3.2. H, *Onchonotellus* cf. *kuruktagensis* Zhang. NMV P1456788; (HFH 22.47-1), a pygidium, ×25.2. I, *Paradamesella* cf. *decemospinosa* Yang. NMV P1456757; (HFH 15a.11), a fragmentary of pygidium, ×9.9.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B

Material. NMV P1456729, collection number HFH 22. 04-1.

Comments. This is an incomplete cranidium; it is similar to the holotype of *C. elongata* Kobayashi (1935: 191, pl. 10, fig. 18), from which it slightly differs in its glabella being near parallel-sided and flat-rounded in the front. The present from is also comparable with *Chuangia* Walcott (1911: 84, pl. 15, figs 3, 3b), but differs in having a parallel-sided, and strongly convex glabella, a narrow fixigena and indistinct eye ridges.

Stratigraphic horizon. Corynexochus hunaensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguan Formation, Upper Cambrian.

Suborder TRINUCLEINA Swinnerton, 1915

Family HAPALOPLEURIDAE Harrington & Leanza, 1957

[= JEGOROVAIIDAE Lu in Lu et al., 1965]

Genus **Jegorovaia** Lu in Wang, 1964

Type species. Jegorovaia expansa Lu in Wang, 1964.

Diagnosis. Cranidium broad; glabella narrow, subpentagonal in shape, almost parallel-sided, sharp in the front, with 3 pairs of short and deep glabellar furrows. Occipital furrow deep; occipital ring slightly broad at middle. Border wide, extending out in a ridge-like line from glabella in the front to the border furrow, frontal border narrow, palpebral lobes small, located at antero-lateral corners of glabella. Fixigena wide, gently convex, its posterior width three times as wide as posterior portion of glabella.

Jegorovaia sp. indet.

Fig. 4F

Material. NMV P1456730, collection number HFH 22. 71-1, poorly preserved in mudstone.

Comments. Cranidium broad, subpentagonal. Fixigena broad; glabella triangular, short; glabellar furrows indistinct, axial furrows narrow and deep. It is comparable with the holotype of *J. expansa* Lu (in Wang 1964: 34, pl. 7, fig. 3), with three pairs of short, deep glabellar furrows. The genus is similar to *Rhadinopleura* Harrington & Leanza (1957: 207, figs 112, 3a, b), but in the latter the palpebral lobes and eye ridges are located at the midlength of the cranidium.

Stratigraphic horizon. Corynexochus hunaensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguan Formation, Upper Cambrian.

Genus **Trigocephalus** gen. nov.

Etymology. Latin: *trigon*, triangular; *cephalus*, head.

Type species. Trigocephalus trigoformis gen. et. sp. nov.

Diagnosis. Cranidium subtriangular. Glabella strongly convex, tapering forward, rounded in the front. Three pairs of glabellar furrows short and weak. Palpebral lobes small, far from the glabella, located at anterior of the glabella. Eye ridges horizontally extending forwards. Occipital rings wide, with a small spine on the surface. Preglabellar field flat. Anterior section of facial sutures strongly contracted forwards, frontal area 'angle-shaped', posterior section obliquely extending backwards. Fixigena wide and flat.

Comments. This new genus may be comparable with *Jiangnania* Lin et al. (1983: 407), but distinctly differs from the latter by its oblique eye ridges, special preglabellar field, anterior border structure, and laterally convex fixigena. The new genus can be distinguished from *Aulacodigma* Öpik (1967: 373) by lacking an anterior border, preglabellar field swelling, and larger palpebral lobes.

Trigocephalus trigoformis sp. nov.

Figs 6F; 7B; 8

Etymology. Latin: *trigon*, triangular; *formis*, triangular shape.

Fig. 7. A, *Chuangiella* cf. *elongata* Kobayashi. NMV P1456729; (HFH 22.04-1), a crushed cranidium, × 10.8. B, *Trigocephalus trionformis* gen. et. sp. nov. NMV P1456731; (HFH 22.06-1), Holotype, a cranidium, × 10.8. C, *Shengia* sp. NMV P1456737; (HFH 21.18), an incomplete cranidium, × 13. D, *Onchonotellus fenguangensis* sp. nov., NMV P1456744; (HFH 22.27), Holotype, a cranidium, × 18. E, F, *Bergeronites* sp. E, NMV P1456752; (HFH 15a.01-1), an incomplete cranidium, × 4.5. F, NMV P1456753; (HFH 15a.01-2), a fragmentary pygidium, × 4.5. G, H, *Corynexochus hunanensis* sp. nov. G, NMV P1456760; (HFH 22.01), Holotype, a complete cranidium, × 40.5. H, NMV P1456761; (HFH 22.21-6), Paratype, an incomplete cranidium, × 36. I, *Linguisaukia* cf. *affinis* Peng. NMV P1456766; (HFH 68.01-1), a cranidium, × 5.

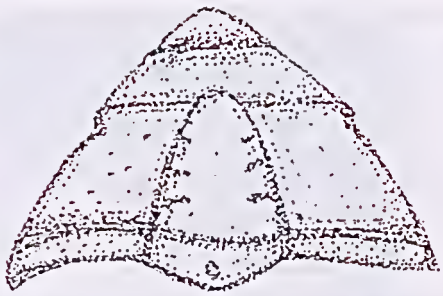


Fig. 8. Trigocephalus trionformis gen. et. sp. nov., from NMV P1456731; (HFH 22.06-1), a cranidium, × 12.5.

Material. Holotype. NMV Pt45673t, collection number HFH 22.06-1. Paratype NMV P1456732, collection number 22.14-2.

Diagnosis. Cranidium triangular in outline; glabella strongly convex and triangular-shaped; greatest convexity at the posterior field.

Description. Glabella tapering forward; glabellar furrows wide and shallow; preglabellar furrow very shallow, and slightly rounded in the front; three pairs of lateral glabellar furrows short, wide and deep; the first pair of glabellar furrows weak, the other two pairs pronounced. Occipital furrow wide and deep, and straight at the middle section, while obliquely extending to both sides. Occipital ring wide at middle, becoming narrow at both sides. Short and lowly ridged palpebral lobes slightly visible at both sides of cranidium, obliquely extending along line of the eye ridge; eye ridge narrow, low and indistinct, extending forward, connecting with antero-lateral corner of glabella. Anterior section of facial suture straight, and strongly contracted forward, connecting each other at axial line, forming an angle in the frontal area; posterior section extending postero-laterally, and resulting in palpebral areas of fixigena and posterior border forming a large triangular region. Posterior border furrow wide and deep; posterior border wide and ridge-shaped; longer frontal lobe of glabella, about one-quarter length of cranidium (Gn), anterior border furrow distinct. Preglabellar field flat; anterior border slightly incurved, short and hook-shaped.

Discussion. The new species is comparable with *Jiangnania miranda* Lin & Zhou (1983: 407, pl. 3, fig 5), but differs from the latter by the position of the palpebral lobes extending direction of the eye ridges. Its preglabellar field and anterior border flat, lacking a pair convex lateral-lobes. The new species also differs from *Araiopleura hunanensis* Peng (1984: 382, pl. 6, figs 9, 10) in its posterior semicircular cranidium, glabellar expanding anteriorly with four pairs of pit-shaped lateral glabellar furrows. In *Araiopleura hunanensis* the eye ridges are narrow and pronounced and extending horizontally to antero-laterally to the glabella.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyuepingia jiantangensis Assemblage, the Tingziguan Formation, Upper Cambrian.

Suborder PTYCHOPARIINA Richter, 1933

Superfamily PTYCHOPARIOIDEA Matthew, 1887

Family PTYCHOPARIIDAE Matthew, 1887

Subfamily EULOMINAE Kobayashi, 1955

Genus **Euloma** Angelin, 1854

Type species. Euloma laeve Angelin, 1854.

Subgenus **Euloma (Archaeuloma)** Lee, 1978

Type species. Euloma (Archaeuloma) guizhouensis Lee, 1978.

Euloma (Archaeuloma) taoyuanensis Peng, 1983

Figs 4G; 6G

Euloma (Archaeuloma) taoyuanensis Peng 1983: 50, pl. 1, fig 5.

Material. NMV P1456733, collection number HFH 80. 01; NMV P1456740, collection number HFH 79.01.

Comments. Semicircular cranidium; glabella strongly convex, almost parallel-sided and cylindrical shaped. The present specimens are identical to *E. (A.) taoyuanensis* Peng (1983: 44, pl. 1, fig. 5) although the cranidium of the latter is subtrapezoidal in outline and slightly convex. This species also resembles *E. (A.) quizhouensis* (Lee in Yin & Li 1978; 459, pl. 160, fig. 11) in general features, but differs from the latter by its wider palpebral areas of fixigena and thinner palpebral lobes.

Stratigraphic horizon. Koldinioidia (Liriannica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, Upper Cambrian.

Family OLENIDAE Burmeister, 1843

Subfamily RHODONASPIDINAE Öpik, 1963

Genus **Rhodonaspis** Whitehouse, 1939

Type species. *Rhodonaspis longula* Whitehouse, 1939.

Rhodonaspis cf. **R. longula** Whitehouse, 1939

Figs 9E; 10

cf. *Rhodonaspis longula* Whitehouse, 1939: 220, pl. 23, fig. 9.
cf. *Rhodonaspis longula*—Öpik 1963: 68, pl. 6, figs 1–7; pl. 7, figs 1, 2; text-figs 21, 22.
cf. *Rhodonaspis longula*—Öpik 1967: 202, pl. 51, fig. 10.

Material. NMV P1456741, collection number HFH 22. 50-2.

Diagnosis. Miniature trilobite; pygidium small, semielliptical in outline; axial ring triangular and convex, divided into four segments and a triangular terminal segment. Pleural regions flat, which include four pairs of pleural segments, each segment bearing short-spine on the end; border narrow.

Comments. The specimen is close to the holotype of *R. longula* Whitehouse (1939: 220, pl. 23, fig. 9) from about two miles south of Tyson's Bore on Glenormiston (*Rhodonaspis* Stage) in Australia; the minor differences between them are that the pygidium of the present species possesses two pairs of terminal spines on the ends of the pleural ring, extending forward and covering the posterior border.

Stratigraphic horizon. *Corynexochus hunanensis–Pseudoyuepingia jiantangensis* Assemblage, Tingziguan Formation, Upper Cambrian.

Subfamily HUNANOLENINAE Liu, 1977

Genus **Huangshiaspis** Liu, 1977

Type species. *Huangshiaspis taoyuanensis* Liu 1977.

Huangshiaspis transversus Liu, 1977

Fig. 9F

Huangshiaspis transversus Liu 1977: 124, pl. 3, figs 1–4.

Material. NMV P1456779, collection number HFH 22. 38-6.

Description. Glabella short (Gn), contracted gently forward, bearing three pairs of glabella furrows. Occipital furrow straight and deep; occipital ring narrow; fixigena very wide, almost occupying two-thirds width of the glabellar base; eye ridges pronounced. Palpebral lobes present at antero-lateral part of glabella, medium-sized, crescent, far away from the glabella. Anterior border convex and ridge-shaped; border wide.

Comments. This species is distinguishable from *H. taoyuanensis* Liu (1977: 124, pl. 3, figs 1–4) by its more wider cranidium, smooth glabella, incurved forward in the front, wider ocular ridges, and a wider anterior border.

Stratigraphic horizon. *Corynexochus hunanensis–Pseudoyuepingia jiantangensis* Assemblage, Tingziguan Formation, Upper Cambrian.

Superfamily ASAPHISCOIDEA Raymond, 1924

Family ANOMOCARELLIDAE Hupe, 1953

Genus **Neoanomocarella** Hsiang, 1963

Type species. *Neoanmocarella asiatica* Hsiang in Jegorova 1963.

Neoanomocarella asiatica Hsiang, 1963

Fig. 4H

Neoanomocarella asiatica Jegorova et al., 1963: 55, pl. 7, figs 9–11.
Neoanomocarella asiatica—Lu et al. 1965: 335, pl. 62, fig 20–22.
Neoanomocarella asiatica—Zhou et al. 1977: 183, pl. 54, figs 3–4.
Neoanomocarella asiatica—Yang 1978: 52, pl. 8, figs 15–17.

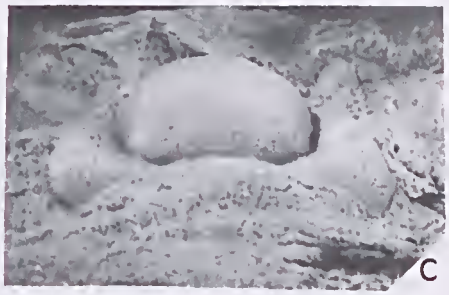
Material. NMV P1456735, collection number HFH 21.01.

Comments. This species is represented by a fragment of a pygidium. The axis of the pygidium is tapered. Pleural lobes are moderately convex, and divided into two to three pleural ridges by different depth and width of the pleural furrows. Border furrow is very shallow, wide, and concave. This species is similar to *N. hunanensis* Yang (1978: 52, pl. 8, fig. 18), from which it many be distinguished by its posterior-middle area of the ridge forming a shallow furrow between the ridge and glabella anterior border.

Stratigraphic horizon. *Neoanomocarella–Proceratopyge (L.) orthogonialis* Assemblage, Laochatian Formation, Upper Cambrian.


B


A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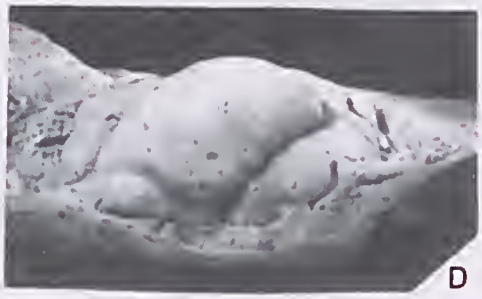
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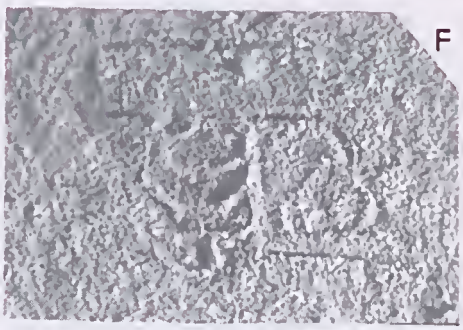
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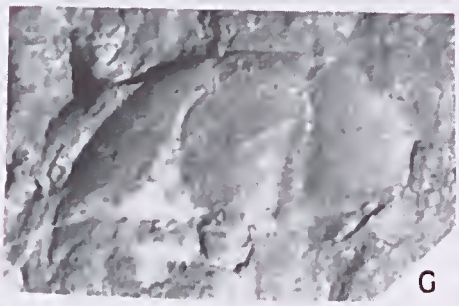
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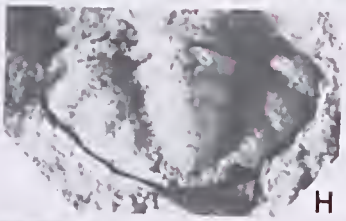
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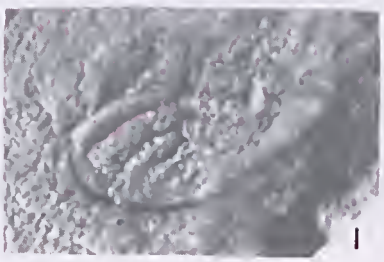
E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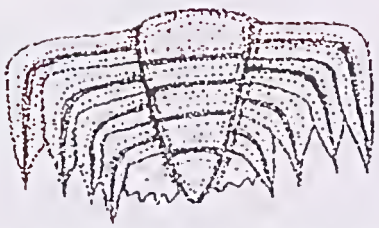


Fig. 10. Rhodonaspis cf. *R. longula*, from NMV P1456741; (HFH 22.50-2), a pygidium, ×42.

Superfamily SOLENOPLEUROIDEA Angelin, 1854

Family LISANIIDAE Chang, 1963

Genus **Eoshengia** Yang, 1978

Type species. Eoshengia subquadrata Yang, 1978.

Eoshengia cf. **spinosa** Yang, 1978

Fig. 9A–D

cf. *Eoshengia spinosa* Yang, 1978: 50, pl. 8, figs 6–8.

Material. NMV P1456736, collection number HFH 15a. 17.

Diagnosis. Cranidium rectangular in outline; glabella gently flat at the anterior; antero-lateral corner of glabella rounded and strongly convex; glabellar furrows weak. Axial furrows deep and wide. Occipital ring expanding at its middle, forming a spine and a small node on the top. Anterior area flat and wide, rapidly becoming narrow at both sides. Border furrow narrow and deep, divided into three sections with many small nodes on the surface.

Discussion. This specimen is similar to the holotype of *E. spinosa* Yang (1978: 50, pl. 8, figs 6–8). A minor difference we can observe is that the anterior border of Yang's species is slightly higher than the other part of the frontal area, which is separated by its shallow furrow. The present specimen morphologically bears resemblance with *E. subquadrata* Yang (1978: 49, pl. 8, figs 1, 2) in general features, but they differ in that our specimen has a strongly convex glabella with an occipital spine, its occipital furrow connects with axial furrow, and its anterior border furrow is divided into three sections.

Stratigraphic horizon. Jiangnaia fuyangensis–Fenghuangella laochatianensis Assemblage, Fengmuping Formation, Middle Cambrian.

Genus **Shengia** Hsiang, 1963

Type species. Shengia quadrata Hsiang in Jegorova et al., 1963.

Shengia sp. indet.

Fig. 7C

Material. NMV P1456737, collection number HFH 21.18.

Description. Glabella cylindrical in outline, strongly convex, and round in the front. Three pairs of glabellar furrows present, weak and unconnected with axial furrows, the last pair diverging. Axial furrows wide and deep; occipital furrow shallower than axial furrows; occipital ring subtriangular, strongly expanding in middle. Frontal area narrow; preglabellar field wider than anterior border, and posterior part gently upturned; palpebral lobe medium sized. Eye ridges pronounced, obliquely extending; palpebral areas of fixigena rather narrow, about one-quarter width of glabella; anterior sections of facial sutures slightly diverging.

Discussion. These morphological features are different from those of any other members of the genus, but poor preservation and lack of sufficient material hinder us from proposing a new species name.

Stratigraphic horizon. Neoanomocarella asiatica–Proceratopyge (L.) orthogonialis Assemblage, Laochatian Formation, Upper Cambrian.

Fig. 9. A–D, *Eoshengia* cf. *spinosa* Yang. A, NMV P1456736; (HFH 15a.17), an incomplete cranidium, ×2.9. B, anterior lateral views of cranidium, ×3.2. C, anterior views of cranidium, ×4.1. D, dorsal and oblique posterior views of cranidium, ×2.8. E, *Rhodonaspis* cf. *R. longula* Whitehouse. NMV P1456741; (HFH 22.50-2), an external model of pygidium with 4 thoracic segments attached, ×22.5. F, *Huangshiaspis transversus* Liu. NMV P1456779; (HFH 22.38-6), an incomplete cranidium, ×22.5. G, *Koldinioidia (Liriamnica) labakouensis* sp. nov., NMV P1456742; (HFH 68.02), Holotype, a cranidium, ×10.8. H, I, *Onchonotellus* cf. *kuruktagensis* Zhang. H, NMV P1456749; (HFH 22.41), a pygidium, ×13.5. I, NMV P1456739; (HFH 22.44), a pygidium, ×25.2.

Family DICERATOCEPHALIDAE Lu, 1954

Genus **Fenghuangella** Yang, 1978

Type species. *Fenghuangella laochatianensis* Yang, 1978.

Fenghuangella laochatianensis Yang 1978

Fig. 13C

Fenghuangella lachatianensis Yang, 1978: 44, pl. 7, figs 12–13.

Material. NMV P1456738, collection number HFH 15a.10.

Diagnosis. Cranidium semicircular-subtriangular in outline; glabella subtriangular and conical in shape, with 1 to 2 pairs of weak glabellar furrows. Occipital ring expanding backward and forming a short spine; palpebral lobes small and present at the front of glabella; eye ridge very weak; fixigena wide.

Comments. This is a miniature trilobite; it agrees well with the holotype of *F. laochatianensis* Yang (1978: 44, pl. 7, figs 12, 13) from the Middle Cambrian of Hunan except that our specimen has a slightly wider frontal area.

Stratigraphic horizon. Jianguaia fuyangensis–Fenghuangella laochatianensis Assemblage, Fengmuping Formation, Middle Cambrian.

Family SHUMARDIIDAE Lake, 1907

Genus **Koldinioidia** Kobayashi, 1931

Type species. *Koldinioidia typicalis* Kobayashi 1931.

Subgenus **Koldinioidia (Liriamnica)** Sherglod, 1980

Type species. *Liriamnica antyx* Sherglod 1980.

Koldinioidia (Liriamnica) labakouensis sp. nov.

Figs 9G; 11

Etymology. From the Labakou village, near the study area.

Material. Holotype, NMV P1456742, collection number HFH 68.02-1; other specimens consists of three cranidia, collection numbers are HFH 68.03, 86.04 and 68.07-5.

Diagnosis. Cranidium semi-circular; glabella rectangular; fixigena broad; genal angle acute, sharp; lacking anterior border; palpebral lobes and eye ridges indistinct; posterolateral limbs broad; occipital ring curve back-word in middle.

Fig. 11. Koldiniodia (Liriamnica) labakouensis sp. nov., from NMV P1456742; (HFH 68.02), a cranidium, × 15.

Description. Cranidium laterally broad; glabella wide (Wa), about half length of the posterior of the cranidium, short, and parallel-sided, with rounded antero-lateral corners; glabellar furrows indistinct. Occipital furrow shallow; palpebral lobes indistinct; fixigena convex, as wide as the glabella (Wa), posterior border furrow wide and deep; obtuse-angle shaped and extending backward. Frontal area narrow and about one-quarter length of cranidium (Le); anterior border very narrow; axial furrows narrow and shallow.

Comparisons and discussion. This species is distinguished from *K. (L.) antyx* Shergold (1980: 65, pl. 18, figs 6–12), by its shorter and wider cranidium, parallel-sided and rounded glabella in the front, lacking any furrow traces on the glabella. In addition, the axial and occipital furrows of the present species are narrow and deep, its posterior border furrow is wide and deep. The new species is similar to *K. paiensis* Lu et al. (1965: 156, pl. 25, fig. 15) and *K. yenchouensis* Lu et al. (1965: 156, pl. 25, fig. 16), from both it differs by its conical glabellar. The new species is comparable with *K. typicalis* Kobayashi (1931: 187, pl. 22, figs 8, 9b), but the latter possesses a pair of genal spine, narrower fixigena, and a pair of shallow pits on the glabella.

The new species was established by some special characters: 1, shape of cranidium; 2, glabellar shape and length; and 3, different glabella frontal area. These diagnosis can distinguish from other species of the genus. Generally, *Koldinidia* belong to small-size trilobites, actually this genus has affinity and *Shumardia* and *Idiomesus*, but *Shumardia* has an obvious axial furrow in the frontal glabella; with a pair of eye-like lobes; while *Idiomesus* has an egg or elliptical shape glabella, and differ from *Koldiuioidia.*

Stratigraphic horizon. Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, Upper Cambrian.

Superfamily AULACODIGMATOIDEA Öpik, 1967

Family AULACODIGMATIDAE Öpik, 1967

Genus **Jiangnania** Lin et Zhou, 1983

Type species. Jiangnania miranda Lin & Zhou 1983.

Jiangnania fuyangensis Lu et Lin 1989

Fig. 13A

Jiangnania fuyangensis Lu et al., 1989: 141, pl. 22, fig. 9.

Material. NMV P1456743, collection number HFH 15a. 1-9.

Description. Miniature trilobite; cranidium semi-circular; glabella narrow and convex. Eye ridges long, narrow, convex, extending to antero-lateral corners of the glabella. Palpebral lobes small and convex, present at antero-lateral part of cranidium. Fixigena very wide, about double the width of glabella. Border wide and slightly concave; anterior border convex; border furrow wide and shallow.

Comments. The species is distinguished from *J. miranda* Lin et al. (1983: 407, pl. 3, fig. 5) by its ball-shaped outline and a convex anterior border in the anterior-middle part.

Stratigraphic horizon. Jiangnania fuyangensis–Fenghuangella laochatianensis Assemblage, Fengmuping Formation, Middle Cambrian.

Superfamily CATILLICEPHALOIDEA Raymond, 1938

Family CATILLICEPHALIDAE Raymond, 1938

Genus **Onchonotellus** Lermontova, 1956

Type species. Solenopleura subcincta Lermontova, 1951.

Onchonotellus fenghuangensis sp. nov.

Figs 7D; 12B; 13D; 14

Etymology. Named after the Fenghuang County.

Holotype. NMV P1456744, collection number HFH 22.27.

Paratype. NMV P1456745, collection number HFH 22. 65-2; NMV P1456746, collection number 22.65-1.

Diagnosis. Miniature trilobite; glabella strongly convex, bearing a pair of shallow pits at antero-lateral corners of glabella. Fixigena triangular, with many small nodes on the surface.

Description. Cranidium subtrapezoidal in outline; glabella almost parallel-sided, slightly converging forwards, acute-shaped in the front, and strongly convex. Glabellar furrows indistinct; occipital ring convex, its distal sides becoming pronouncedly narrow; axial furrows narrow and deep. Eye ridges low and flat, extending to antero-lateral sides of cranidium; palpebral lobes small and convex, crescent. Fixigena narrow and convex, slightly narrower than glabella. Preglabellar field moderately wide and concave; border furrow straight, narrow and shallow; posterior border furrow wide and deep; posterior border narrow, nearly equal to glabellar width. Pygidium small and semielliptical in outline; axis of pygidium convex, with three segments and a terminal segment, about one-third width of pygidium.

Discussion. This new species resembles *O. longicepta* Zhou (1977: 162, pl. 49, figs 7, 8), from the Upper Cambrian Tingziguan Formation, Hunan Province, China, but the latter lacks the preglabellar field, and its glabella is rounded in the front. The new species is distinguishable from *O. abnormis* Ivshin (1956: 28, pl. 9, figs 9–16) from the middle Upper Cambrian of the Selety River Basin, central Kazakhstan. The latter species differs by its elliptical glabella and a narrow preglabellar field.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguan Formation, Upper Cambrian.

Onchonotellus cf. **kuruktagensis** Zhang, 1981

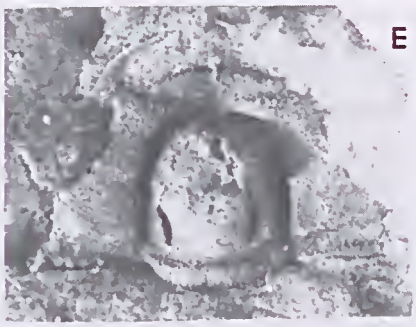
Figs 6H; 9H, I; 12C–E; 13E

cf. *Onchonotina kuruktagensis* Zhang 1981: 169, pl. 63, figs 2–4.

cf. *Onchonotina kuruktagensis*—Xiang & Zhang 1985: 117, pl. 39, figs 2–4.

cf. *Onchonotellus kuruktagensis*—Peng 1992: 65, figs 37, 39D–I.

Material. NMV P1456747, collection number HFH 22.19-2; NMV P1456748, collection number HFH 22.03; NMV P1456749, collection number 22.41; NMV P1456750, collection number HFH 22.06-2; NMV P1456739; collection number HFH 22.44; NMV P1456734, collection number HFH 22.31, NMV P1456788, collection number HFH 22.47-1.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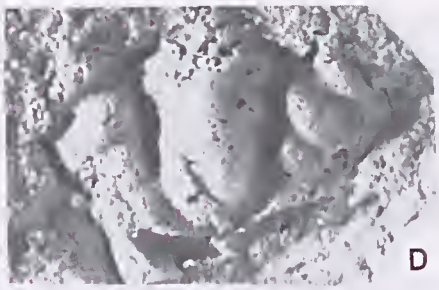
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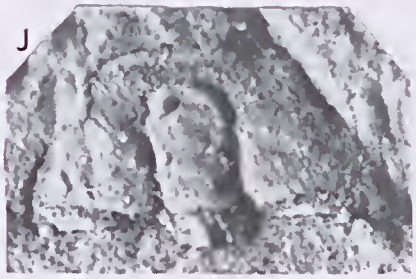
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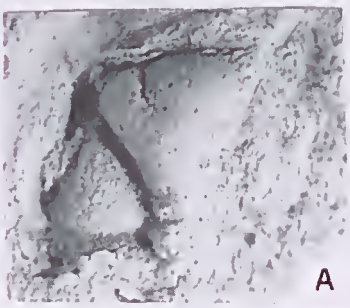
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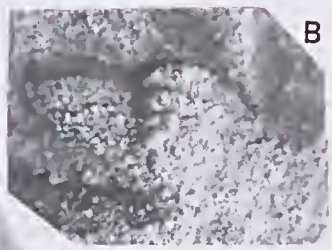
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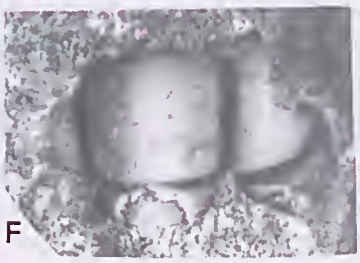
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Diagnosis. Cranidium trapezoidal in outline; glabella subsquare, strongly convex, square-rounded in the front, bearing three pairs of weak glabellar furrows, obliquely extending backwards. Frontal area gently convex; preglabellar field slightly conceived. Anterior border gently convex, its middle part wider than the distal part; border furrow straight and deep. Palpebral lobes small. Eye ridges very weak; occipital ring narrow at the distal; occipital furrow moderately wide and deep. Fixigena gently convex, narrow; posterior border furrows wide and shallow, posterior upturned. Axial furrow narrow and deep. Pygidium subtriangular in outline, axis strongly convex, extending to border, about one-third as wide as pygidium, with four segments and a terminal segment. Pleural region narrow and convex; pleural furrows indistinct; interpleural furrows wide and shallow; border bearing many small nodes on the surface.

Comments. This species is close to *O. kuruktagensis* Zhang (1981: 169, pl. 63, figs 2–4), from the Torsuqtugh Formation of Quruq-Tagh, Xinjiang, China. The minor difference is that the former has a wider frontal area and a pair of weaker eye ridges. The present species is distinguished from *O. fenghuangensis* sp. nov. by its egg-shaped glabella and much wider anterior glabella. This species differs from *O. vigilans* Lu in Wang (1964: 34, pl. 7. fig. 9) by its smaller preglabellar field, forming a concave region at the axial line, lacking glabellar furrows and eye ridge traces.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguan Formation, Upper Cambrian.

Genus **Distazeris** Raymond, 1937

Type species. Distazeris acuta Raymond, 1937.

Distazeris cf. **hunanensis** Peng, 1987

Fig. 12F

Distazeris hunanensis Peng 1987: 93, pl. 6, figs 7–9.

Material. NMV P1456751; collection number HFH 15a.19.

Description. Cranidium semieircular and laterally broad; glabella convex, slightly expanding forwards, rounded in the front, bearing 3 pairs of glabellar furrows, the last two pairs pronounced. Axial furrows narrow and deep; frontal area poorly preserved; fixigena convex, about two-thirds of glabellar width; occipital ring incomplete.

Comments. D. dongtingensis Peng (1987: 94, pl. 4, fig. 6) is somewhat similar to the present species in many aspects, but differs from the latter by its more strongly expanded glabella, with net-shaped fold on the fixigena, and smaller concave pitting on the glabella.

Present species is comparable with *D. (Paradistazeris) sichuanensis* Zhu in Zhang (1980: 380, pl. 132, figs 13–15), but the latter bears 4 pairs of glabellar furrows, the last 2 pairs being groove-shaped and deep.

Stratigraphic horizon. Jiangnania fuyangensis–Fenghuangella laochtianensis Assemblage, Fengmuping Formation, Middle Cambrian.

Superfamily DAMESELLOIDEA Kobayashi, 1935

Family DAMESELLIDAE Kobayashi, 1935

Subfamily DREPANURINAE Hupé, 1953

Genus **Bergeronites** Sun, 1965

[= **Palaeadotes** Öpik, 1967]

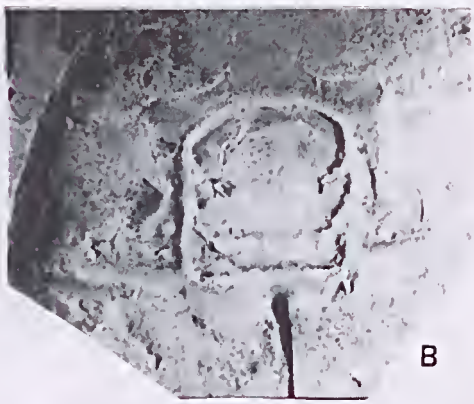
Type species. Drepanura ketteleri Mönke, 1903.

Bergeronites sp. indet.

Fig. 7E, F

Material. NMV P1456752; collection number HFH 15a.01-1, NMV P1456753; collection number HFH 15a.01-2.

Fig. 12. A, *Corynexochus plumula* Whitehouse. NMV P1456758; (HFH 22.48-3), an incomplete cranidium, ×22.5. B, *Onchonotellus fenghuangensis* sp. nov., NMV P1456746; (HFH 22.65-1), an incomplete pygidium, ×11.7. C–E, *O.* cf. *kuruktagensis* Zhang. C, NMV P1456750; (HFH 22.06-2), an incomplete external model of pygidium, ×10.8. D, NMV P1456734; (HFH 22.31), a pygidium, ×27. E. NMV P1456747; (HFH 22.19-2), a cranidium, ×16.2. F, *Distazeris* cf. *hunanensis* Peng, 1987, NMV P1456751; (HFH 15a.19), an incomplete cranidium, ×22.5. G, H, *Schmalenseeia sinensis* Yang. G, NMV P1456754; (HFH 15a.21-2), a complete shield, ×9. H, NMV P1456755; (HFH 15a.22-1), a complete shield, ×9.9. I, *Paradamesella* cf. *typica* Yang. NMV P1456756; (HFH 15a.14), a fragmentary pygidium, ×4.1. J, *Tuojiangella tuojiangensis* gen. et. sp. nov. NMV P1456762; (HFH 22.07-1), Holotype, a complete cranidium, ×16.2.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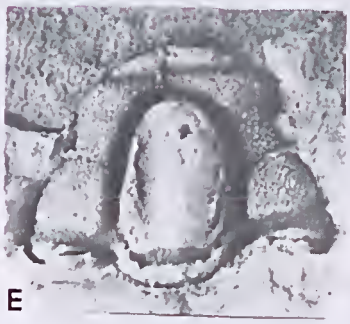
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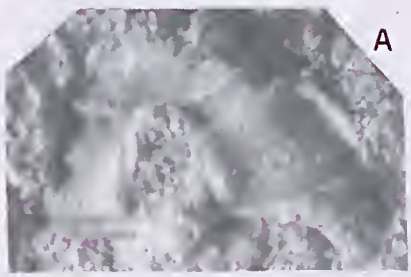
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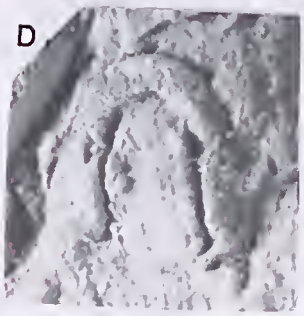
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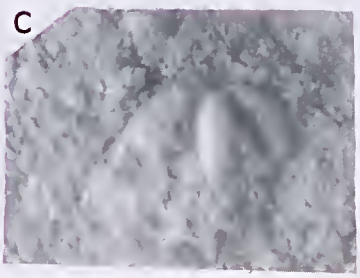
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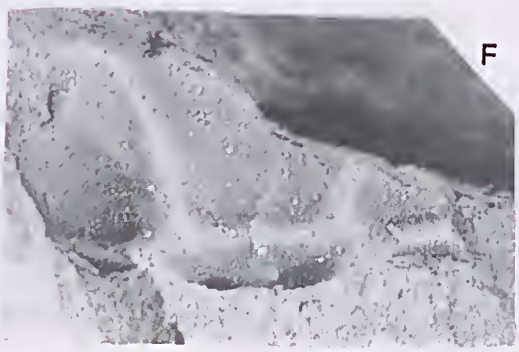
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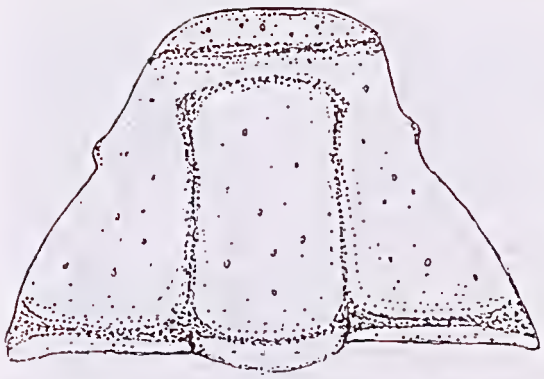


Fig. 14. Onchonotellus fenghuangensis sp. nov., from NMV P1456744; (HFH 22.27) a cranidium, ×22.

Description. Glabella trapezoid shape, distinctly expanded in base, and strongly convex; bearing four pairs of glabellar furrows; the first pair obliquely extending forward; the second pair extending horizontally, narrow at near the axial furrows and expanding near the axial-line; the third pair unconnected with axial furrows; and the last pair fork-shaped. Occipital ring expanding forward at the middle part; occipital furrow deep and wide at both sides, bearing a node on the top. Eye ridges poorly preserved. Fixigena very wide, about half width of glabella (Wa), bearing many nodes on the surface. Pygidium bearing a pair of anterior pleural spines and three pairs of lateral spines; pleural furrows wide and shallow.

Comments. This specimen is similar to *B. austriacus* Yang (1978: 62, pl. 11, figs 1–4) from the top of Middle Cambrian, west Hunan, China; but the glabellar furrows of the latter species are deeper than in the present specimens, and their pygidium pleural furrows are deep and concave. Therefore, the present specimens probably represent a new species of the genus.

Stratigraphic horizon. Jiangnaia fuyangensis–Fenghuangensis laochatiaensis Assemblage, Fengmuping Formation, Middle Cambrian.

Genus **Schmalenseeia** Moberg, 1903

Schmalenseeia sinensis Yang, 1978

Fig. 12G, H

Schmalenseeia sinensis Yang, 1978: 63, pl. 13, fig. 10.

Material. NMV P1456754, collection number HFH 15a.21-2; NMV P1456755, collection number 15a.22-1.

Description. Shield oval-shaped; cranidium semicircular in outline; glabella sharp and conical shaped, bearing three pairs of transversal glabellar furrows, wide and deep at both sides and narrow and shallow at middle. Axial furrows shallow. Palpebral lobes long and incurved.

Comments. This species is distinguished from *S. gostinensis* Jago (1972: 232, pl. 44, figs 19–22) by its narrower posterior limb and shallower posterior border furrow.

Stratigraphic horizon. Jiangnaia fuyangensis–Fenghuangella laochatianensis Assemblage, Fengmuping Formation, Middle Cambrian.

Family DAMESELLIDAE Kobayashi 1935

Genus **Paradamesella** Yang, 1978

Type species. Paradamesella typica Yang, 1978.

Paradamesella cf. **typica** Yang, 1978

Fig. 12I

cf. *Paradamesella typica* Yang 1978: 56, pl. 12, figs 1–8.

Material. NMV P1456756, collection number HFH 15a.14.

Comments. This is a fragment of a pygidium lacking axis of the pygidium. The antérior pleural spines are strong. The pygidium is characterised by thin and long spines, many small nodes are present on the surface as well. This specimen is close to *P. typica* Yang (1978: 56, pl. 12, figs 1–8) though bearing slightly longer pygidium spines. This specimen is somewhat similar to *P. paratypica* Yang (1978: 56, pl. 12, fig. 9) as well, but the latter possesses a flat posterior border on the pygidium.

Fig. 13. A, *Jiangnania fuyangensis* Lu et Lin. NMV P1456743; (HFH 15a.01-9), an incomplete cranidium, ×20.7. B, *Linguisaukia* cf. *affinis* Peng. NMV P1456767; (HFH 68.01-2), an external model of cranidium, ×5. C, *Fenghuangella laochatianensis* Yang. NMV P1456738; (HFH 15a.10), a cranidium, ×40.5. D, *Onchonotellus fenghuangensis* sp. nov., NMV P1456745; (HFH 22.65-2), Paratype, an incomplete cranidium, ×12.6. E, *O.* cf. *kuruktagensis* Zhang. NMV P1456748; (HFH 22.03), a complete cranidium, ×10.8. F, *Corynexochus plumula* Whitehouse. NMV P1456759; (HFH 22.51), a fragmentary cranidium, ×13.5. G, H, *Ivshinaspis formosa* sp. nov. G, NMV P1456764; (HFH 68.13), Holotype, a cranidium, ×8.1. H, NMV P1456765; (HFH 68.14), Paratype, an incomplete cranidium, ×9.

Paradamesella cf. **decemospinosa** Yang, 1978

Fig. 6I

cf. *Paraadamesella decemospinosa* Yang 1978: 57, pl. 12, fig. 11.

Material. NMV P1456757, collection number HFH 15a.11.

Comments. The present specimen is an incomplete pygidium with a flat border and bearing some strong spines; the first pair of pygidium furrows are the largest among the three pairs. Pleural regions are slightly convex; some small nodes are irregularly distributed on the surface. This specimen is similar to *P. decemospinosa* Yang (1978: 57, pl. 12, fig. 11) in many aspects, but slightly differs from the latter by its deeper anterior border furrow on the pygidium. The species differs from *P. novemospinosa* Yang (1978: 57, pl. 12, fig. 10) in having much more pygidium spines.

Stratigraphic horizon. Jiangnania fuyangensis–Fenghuangella laochatianensis Assemblage, Fengmuping Formation, Middle Cambrian.

Family CORYNEXOCHIDAE Angelin, 1845

Genus **Corynexochus** Angelin, 1854

Type species. Corynexochus spinulosus Angelin, 1854.

Corynexochus plumula Whitehouse, 1939

Figs 12A; 13F

Corynexochus plumula Whitehouse 1939: 234, pl. 24, figs 8–10.
Corynexochus plumula—Öpik 1967: 178, pl. 3, figs 1–11.
Corynexochus plumula—Palmer 1968: 42, pl. 10, figs 15, 16, 19–22.
Corynexochus plumula—Zhou et al. 1977: 136, pl. 43, figs 10–12.
Corynexochus plumula—Shergold 1982: 47, pl. 14, figs 1–7.
Corynexochus plumula—Liu 1982: 304, pl. 214, fig. 13.
Corynexochus plumula—Qiu et al. 1983: 63, pl. 20, fig. 13.
Corynexochus plumula—Xiang & Zhang 1985: 100, pl. 27, figs 2–7.
Corynexochus plumula—Lisogor et al. 1988: 68, pl. 7, fig. 7.
Corynexochus plumula—Peng 1992: 34, figs 16B–I, P.

Material. NMV P1456758, collection number HFH 22.48-3; NMV P1456759, collection number HFH 22.51.

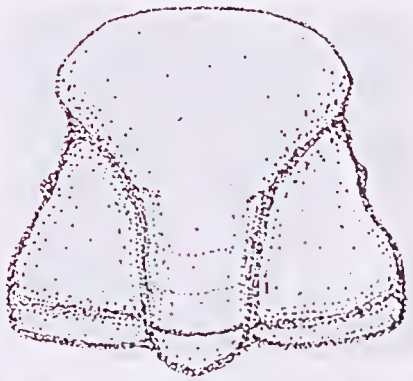


Fig. 15. Corynexochus hunanensis sp. nov., from NMV P1456760; (HFH 22.01), a cranidium, ×50.

Description. Glabella strongly expanding forwards, nearly flat and straight in the front, bearing three pairs of glabellar furrows, the last pair short and diverging obliquely forwards; axial and occipital furrows deep; palpebral lobes at anterior of the glabella medium-sized; posterior border wide.

Comments. The species comparable with *C. chinses* Lin & Zhang (in Zhu et al. 1979: 88, pl. 37, fig. 5) in general outline, but the latter possesses more straight axial furrows, longer glabella, shorter anterior border, longer palpebral lobes and narrower fixigena.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyunepingia jiantangensis Assemblage, Tingziguan Formation, Middle Cambrian.

Corynexochus hunanensis sp. nov.

Figs 7G, H; 15

Etymology. For Hunan Province, China.

Holotype. NMV P1456760, collection number HFH 22.01.

Paratype. NMV P1456761, collection number HFH 22.21-6.

Diagnosis. Miniature trilobite. Glabella narrow and moderately convex, strongly expanding in the front, and nearly parallel-sided in the posterior; lacking frontal area. Axial furrows narrow and deep; glabella narrow, convex and ridge-shaped along axial line.

Description. Cranidium circular-triangle in outline; glabella long and convex. Three pairs of glabellar furrows distinct; the posterior two pairs wide and shallow; the frontal pair of glabellar furrows short. Axial furrows wide and deep, bearing a pair of deep and concave small pit at posterior of glabella. Occipital furrow shallow and distinct; occipital ring strongly expanding at middle-posterior part, becoming narrow at distal. Palpebral lobes narrow and short, slightly extending outward. Anterior section of facial sutures short, and contracting forward, then turning inwards, cutting at the antero-lateral corner of glabella. Posterior section of facial suture long and extending to the postero-lateral side. Fixigena narrow.

Discussion. This new species is similar to *C. elongatus* Yang (1991: 125, pl. 9, figs 6–8) in some morphologieal features, but the latter has less expanded glabella and its occipital ring is longer than that of the new speeies.

Stratigraphic horizon. Corynexochus hunaensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguang Formation, Upper Cambrian.

Superfamily ORYCTOCEPHALOIDEA
Beecher, 1897

Family CHEIRUROIDEIDAE Chang, 1963

Genus **Tuojiangella** nov.

Etymology. For the Tuojiang village, a small village near the type locality.

Type species. Tuojiangella tuojiangensis gen. et. sp. nov.

Diagnosis. Cranidium trapezoidal in outline, flat; glabella cylindrical and flat in the front, bearing three pairs of wide and shallow transglabellar furrows. Preglabellar field and frontal border narrow; palpebral lobes small. Anterior section of suture slightly contraeted forward, posterior section eurved and diverging out-laterally.

Comments. The new genus is comparable with *Cheiruroides (Neocheiruroides)* Yin (1978: 433) in having a narrow preglabellar field, but the former has weak transglabellar furrows and pronounced eye lobes.

Tuojiangella tuojiangensis sp. nov.

Figs 12J; 16A; 17

Etymology. For the Tuojiang River, which passes through the study area.

Holotype. NMV P1456762, collection number HFH 22.07-1.

Paratype. NMV P1456763, collection number HFH 22.69-5.

Description. Miniature trilobite. Cranidium trapezoidal in outline, flat and straight in the front; glabella moderately convex, cylindrieal, and rounded in front, bearing three pairs of transglabellar furrows; the first pairs flat and straight, slightly bent backwards at the middle; the last two pairs wide and shallow in the middle. Occipital furrow wider and deeper than glabellar furrows. Occipital ring wide at the middle, both sides becoming narrow, and obliquely extending forwards. Frontal area narrow, about one-tenth as long as cranidium (Lc). Preglabellar field as wide as anterior border, lacking eye ridge; palpebral areas of fixigena width are slightly less than the glabella (Wa). Anterior section of faeial suture pronouncedly contracted forwards and then roundly turning inward, obliquely cutting anterior border; posterior section of facial suture long, curved, extending backwards and forming wide postero-lateral limbs. Posterior border furrows wide and deep; posterior border ridge-shaped, becoming wide from inside to outside.

Discussion. The new species is comparable with *Cheiruroides (Neocheiruroides) reticus* Tchernysheva (1961: 48, pl. 6, figs 1–8), but differs from the latter by its shorter and more strongly convex posterior part of glabella and narrower frontal border. Occipital furrow of this new speeies is narrower than that of the latter.

Stratigraphic horizon. Corynexochus hunaensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguang Formation, Upper Cambrian.

Superfamily REMOPLEURIDOIDEA
Hawle & Corde, 1874

Family REMOPLEURIDIDAE
Hawle & Corde, 1874

Subfamily RICHARDSONELLINAE
Raymond, 1924

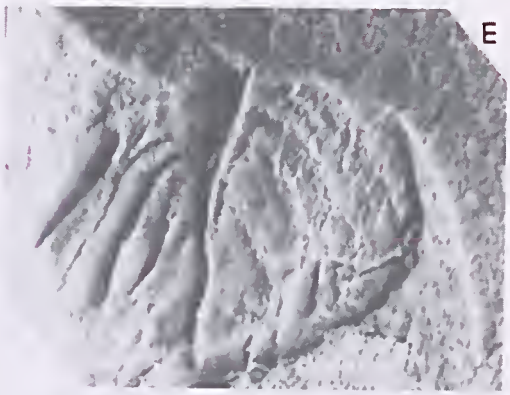
Genus **Ivshinaspis** Petrunina, 1973

Type species. Ivshinaspis ivshini Ergaliev, 1980.

Ivshinaspis formosa sp. nov.

Figs 13G, H; 18

Etymology. Latin: *formosus*, meaning beautiful.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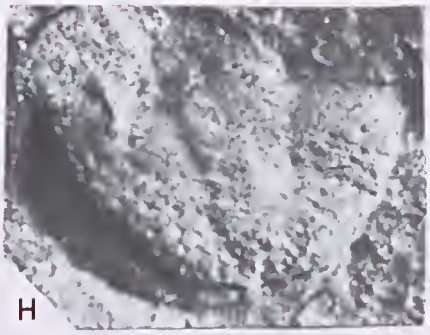
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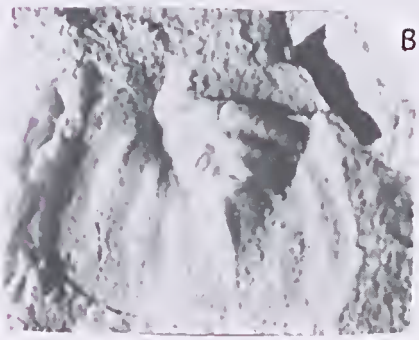
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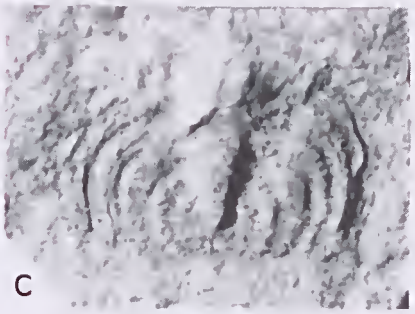
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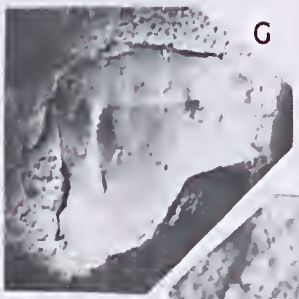
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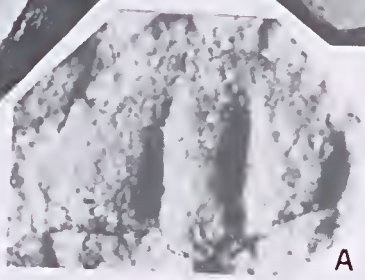
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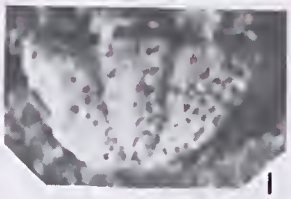
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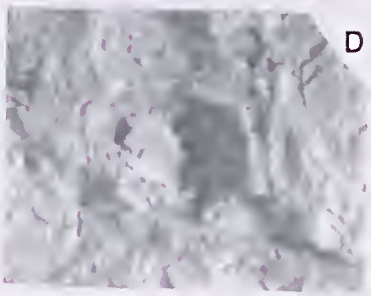
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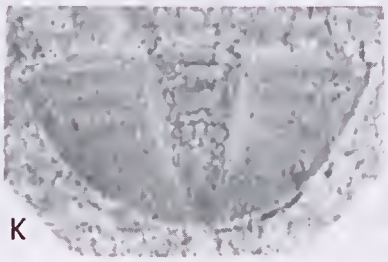
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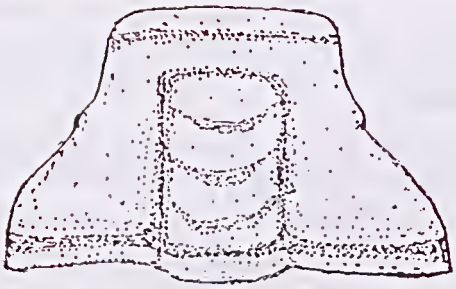

Fig. 17. Tuojiangella tuojiangensis gen. et. sp. nov., from NMV P1456762; (HFH 22.071), a cranidium, × 27.

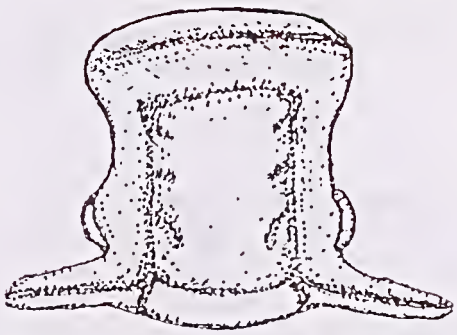

Fig. 18. Ivshinaspis formosus sp. nov., from NMV P1456764; (HFH 68.13), a cranidium, × 8.4.

Holotype. NMV P1456764, collection number HFH 68.13.

Paratype. NMV P1456765, collection number HFH 68.14.

Diagnosis. Glabella rectangular and slightly rounded in the front, long and convex, bearing three pairs of glabellar furrows. Anterior border wide; border furrow wide and shallow. Posterior border narrow.

Description. Cranidium long (Lc), length and width ratio at the anterior part close to 3 : 2. Glabella parallel-sided, cylindrical-shaped, moderately convex, and slightly rounded in the front. Three pairs of glabellar furrows distinct; the anterior two pairs shallow and short, slightly obliquely diverging; the last pair wide, deep, obliquely diverging and becoming strong backwards. Occipital ring moderately wide; occipital furrow straight, and shallow. Palpebral lobes medium-sized, crescent, located posterior of the middle line of glabella. Fixigena gently convex and less than half as wide as glabella (Wa). Preglabellar field wide and slightly convex. Border furrow wide and shallow; anterior border moderately long at its middle part and slightly narrow at its end. Anterior section of facial suture slightly diverging forwards, forming an angle about 30° with the axial line, then incurving inwards and extending to the anterior border; posterior section slightly extending laterally and forming 35° with the posterior border; posterior border furrows wide and shallow.

Discussion. This species differs slightly from *I. crispa* Petrunina (1973: 63, pl. 2, figs 7, 8, 10, 16) by its parallel-sided glabella, slightly diverging anterior section of the facial sutures and the gently convex frontal border. The present species is comparable with *I. quadrata* Peng (1984: 355, pl. 10, figs 14, 15), but differs from the latter by the shorter posterior glabellar, narrower anterior border, and narrower and deeper border furrows.

Stratigraphic horizon. Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, Upper Cambrian.

Family SAUKIIDAE Ulrich & Resser, 1933

Genus **Linguisaukia** Peng, 1984

Type species. Linguisaukia spinata Peng, 1983.

Fig. 16. A. *Tuojiangella tuojiangensis* gen. et. sp. nov. NMV P1456763; (HFH 22.69-5), Paratype, a cranidium, × 36. B, C, *Linguisaukia* cf. *affinis* Peng. B, NMV P1456768; (HFH 68.05), an incomplete pygidium, × 13.5. C, NMV P1456769; (HFH 22.08), an incomplete pygidium, × 22.5. D, *Saukia* sp. NMV P1456771; (HFH 69.17-1), an incomplete cranidium, × 13.5. E–K, Gen. et. sp. indet. E, Gen. et. sp. indet. No. 1, NMV P1456772; (HFH 22.15-2), a fragmentary pygidium, × 14,4. F, G, Gen. et. sp. No. 2. F, NMV P1456773; (HFH 68.15), a fragmentary cranidium, × 2.3. G, NMV P1456774; (HFH 68.16), a fragmentary cranidium, × 2.5. H, I, Gen. et. sp. indet. No. 3. H, NMV P1456775; (HFH 68.17), a pygidium, × 22.5. I, NMV P1456776; (HFH 68.18), a pygidium, × 16.2. J, Gen. et. sp. indet. No. 4, NMV P1456777; (HFH 48.0), an incomplete cranidium with a party of thoracic segments, × 13.5. K, Gen. et. sp. indet. No. 5, NMV P1456778; (HFH 80.3-3), a pygidium, × 16.2.

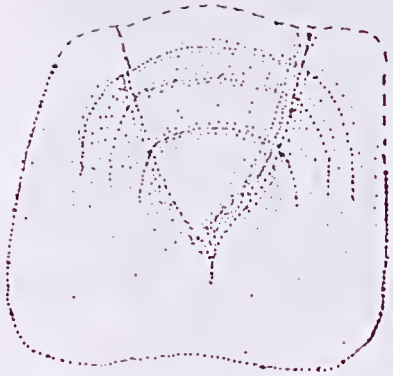

Fig. 19. Linguisaukia cf. *affinis*, from NMV P1456768; (HFH 68.05), a pygidium, × 11.

Linguisaukia cf. affinis Peng 1984

Figs 7I; 9I; 13B; 16B, C; 19

cf. *Linguisaukia affinis* Peng 1984: 348, pl. 7, figs 3–7.

Material. NMV P1456766, collection number HFH 68.01-1; NMV P1456767, collection number HFH 68.01-2; NMV P1456768, collection number HFH 68.05; NMV P1456769, collection number HFH 22.08; NMV P1456770, collection number HFH 22.48-1.

Description. Cranidium rectangular in outline; glabella subrectangular, parallel-sided, evenly rounded anteriorly, straight on flanks, defined by deep, broad axial and preglabellar furrows; two pairs of lateral glabellar furrows distinct. Occipital furrow deep and wide. Frontal glabellar lobe large, occupying one-third of the glabellar length; occipital ring wide, about one-fifth as wide as glabella (Wa), bearing a long and stout spine at its middle. Anterior section of facial suture almost straight, originating from the anterior end of the palpebral lobe, and extending to the anterior cranidial margin by approximately 90°; posterior sections diverging transversely from the posterior of the palpebral lobes, then incurved backwards evenly to contact the posterior cranidial margin, and enclosing the transverse blade-shaped posterolateral limbs. A row of tiny spines developed along posterior margin. Pygidium round-square in outline; axial ring moderately convex and conical shape with three to four segments and a terminal axial segment. Pleural region flat.

Comments. The specimen is close to *L. affinis* Peng (1984: 348, pl. 7, figs 3–7) in many aspects, but slightly differs from the latter by its posterior glabella being gently contracted forwards and rounded in the front. This species is distinguishable from the type species of genus, *L. spinata* Peng (1984: 347, pl. 6, figs 4–8), by its smaller anterior glabella.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguang Formation, Upper Cambrian.

Genus Saukia Walcott, 1914

Type species. Dikelocephalus lodensis Whitfield, 1880.

Saukia sp. indet.

Fig. 16D

Material. NMV P1456771, collection number HFH 69.17-1.

Comments. This is an incomplete cranidium, characterised by its parallel-sided and moderately convex glabella; glabellar furrows with many thick nodes on the surface. These morphological features indicate that this specimen probably belongs to a new species of Saukia Walcott, but is indeterminate due to insufficient material and poor preservation.

Stratigraphic horizon. Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, Upper Cambrian.

Superfamily DIKELOCEPHALOIDEA Miller, 1889

Gen. et. sp. indet. 1

Fig. 16E

Material. NMV P456772, collection number HFH 22.15-2.

Description. Pygidium elliptical in outline; axis of pygidium conical, short and convex, about one-third as long as the pygidium. Axis segment indistinct; pleural region flat and wide; pleural and interpleural furrows narrow and deep; pleural lobe divided into three pairs of pleural rings; border furrow indistinct.

Comments. This specimen is similar to that of *Jiangnania hunanensis* Peng (1987: 111, pl. 7, figs 2, 3) in similar shape of axial of pygidium, and interpleural furrows, but the latter has a narrow furrow at the posterior axial lobe of pygidium.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyuepingia Assemblage, Tingziguan Formation, Upper Cambrian.

Gen. et. sp. indet. 2

Fig. 16F, G

Material. NMV P1456773, collection number HFH 68.15; NMV P1456774, collection number HFH 68.16.

Description. Glabella rectangular and flat; glabellar furrows not observed; a pair of anterior pits at antero-lateral corner of the glabella deep and distinct; axial furrow narrow and deep. Preglabellar furrow shallow and indistinct; a pair of oblique furrows present at antero-lateral corner of glabella, shallow and wide. Anterior section of facial sutures long, slightly diverging, and inearably turning inward and extending to the middle-line. Preglabellar field wide and flat; border slightly sharp, and anteriorly convex at the middle; border furrows indistinct.

Comments. This species is represented by two incomplete cranidia, poorly preserved in the siltstone. It is similar to *Quadraticephalus* Sun (1924: 63, pl. 4, fig. 6a–b) in the outline of cranidium, but differs from the latter by its convex posterior glabella and slightly deep axial furrows and its surface, bearing node. These characteristics suggest that it probably belongs to a new species of a new genus of the Ptychaspididae, but a formal generic and specific identification is hampered due to insufficient material.

Stratigraphic horizon. Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, Upper Cambrian.

Family CERATOPYGIDAE Linnarsson, 1869

Gen. et. sp. indet. 3

Fig. 16H, I

Material. NMV P1456775, collection number HFH 68.17; NMV P1456776, collection number HFH 68.18.

Description. Pygidium semicircular in outline; axis conical and gently convex, long, extending to posterior border; axial furrows shallow, with four pairs of short and pit-shaped furrows on the axis of the pygidium, suggesting larval age. Pleural lobes flat, pleural and interpleural furrows weak; axial furrow of pygidium distinct, increasing in width and depth near anterior margin, connecting with furrows on the pleural lobes surface, marked by many small concave pitting. Border narrow.

Comments. The present species is comparable with *Charchaqia norini* Troedsson (1937: 48, pls 1, 6, figs 1–12) in having a similar pygidium outline, but the posterior axis of the pygidium of the later is narrow and lacks small pitting on the surface.

Stratigraphic horizon. Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, Upper Cambrian.

Gen. et. sp. indet. 4

Fig. 16J

Material. NMV P1456777, collection number HFH 48.

Comments. An incomplete shield is obtained from the present collection. It is characterised by a rectangular and moderately convex glabella with parallel sides. The glabella is slightly contracted at the middle; glabella furrows indistinct; small palpebral lobes present at middle-anterior of the glabella. Posterior section of facial sutures extending postero-laterally; border furrow wide and shallow. These features indicate that the present specimen probably belongs to a new genus of Cerapotygidae; however, this potential new genus and species are presently indeterminate due to poor preservation and insufficient material.

Stratigraphic horizon. Corynexochus hunanensis–Pseudoyuepingia jiantangensis Assemblage, Tingziguan Formation, Upper Cambrian.

Gen. et. sp. indet. 5

Fig. 16K

Material. NMV P1456778, collection HFH 80.03-3.

Description. Pygidium semicircular in outline; axis of pygidium gently convex, triangular-shaped, and extending to the border; bearing four axial segments and a terminal segment; axial furrows broad and shallow. Pleural field slightly convex, pleural and interpleural furrows weak. Border narrow.

Comments. The present specimen resembles *Charchaqia norini* Troedsson (1937: 48, pl. 5, fig. 1; pl. 6, figs 1–12), but differs by its broader posterior axis of the pygidium.

Stratigraphic horizon. Koldinioidia (Liriamnica) labakouensis–Ivshinaspis formosa Assemblage, Jiantang Formation, the Upper Cambrian.

ACKNOWLEDGEMENTS

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